Northeast Fisheries Science Center Reference Document 97-11

# 24th Northeast Regional Stock Assessment Workshop (24th SAW)

## *Public Review Workshop*

October 1997

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*A Report of the 24th 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**
**Northeast Fisheries Science Center**
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This report is a product of the 24th Northeast Regional Stock Assessment Workshop (24th SAW). Proceedings and products of the 24th SAW are scheduled to be documented and released as issues of the *Northeast Fisheries Science Center Reference Document* series. Tentative titles for the 24th SAW are:

An alternative stock assessment analysis for Gulf of Maine Atlantic cod

Assessment of the Georges Bank Atlantic cod stock for 1997

Assessment of the Gulf of Maine Atlantic cod stock for 1997

Assessment of the Southern New England yellowtail flounder stock for 1997

Evaluation of vessel logbook data for discard and catch-per-unit-of-effort (CPUE) estimates

Proration of 1994-96 commercial landings of Atlantic cod, haddock, and yellowtail flounder

Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW): Public Review Workshop

Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments

Stock assessment of Georges Bank yellowtail flounder for 1997

Ten-year projections of landings, spawning stock biomass, and recruitment for the five groundfish stocks considered at the 24th Northeast Regional Stock Assessment Workshop (24th SAW)

U.S. assessment of the Georges Bank haddock stock, 1997

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# OVERVIEW

## Introduction

The Public Review Workshop of the 24th Northeast Regional Stock Assessment Workshop (SAW-24) 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 July 10, 1997 in Wakefield, MA during the NEFMC meeting and the second session was held August 14, 1997 in Philadelphia, PA during the MAFMC meeting.

The purpose of the Workshop was to present the assessment results and management advice on Gulf of Maine cod, Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, and Southern New England yellowtail flounder, peer reviewed by the Stock Assessment Review Committee at its May 19-23, 1997 meeting, to managers, fisheries representatives, and the public. Copies of the SAW-24 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 assessments of these five stocks were also under review by a National Research Council committee which was scheduled to report to Congress in the fall of 1997.

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 *24th Northeast Regional Stock Assessment Workshop (24th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments*. A panel of experts comprised of Dr. Steven Murawski (Chief, NEFSC Population Dynamics Branch), Mr. Ralph Mayo (Chairman, SARC Northern Demersal Working Group), and Dr. William Overholtz (Chairman, SARC Coastal/Pelagic Working Group) assisted Dr. Anderson in the question-and-answer period at the NEFMC session. Dr. Overholtz and Dr. Mark Terceiro (NEFSC Population Dynamics Branch) assisted Dr. Anderson at the MAFMC session.

## Status Summaries

### Gulf of Maine Cod

The stock is presently at a low biomass level and remains over-exploited. Fishing mortality in 1996 increased from the 1993 level, while spawning stock biomass (SSB) declined to record-low levels in 1994 and is expected to decline further in 1997. At the present level of exploitation and probable levels of recruitment in the near term, the decline in SSB is expected to accelerate. If the current level of exploitation continues, landings are expected to decline to levels not recorded since the 1960s and SSB to decline to a further record low in 1999. Current SSB is dominated by a succession of very low to average year classes produced during 1988-1995.

An immediate and substantial reduction in fishing mortality of about 70% is required to halt the continuing decline in SSB. Rebuilding the SSB will require even further reductions over the long term. If fishing mortality is not reduced from the present level, SSB will decline further beyond the current record low.

### Georges Bank Cod

The stock is at a low biomass level and is over-exploited. 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 and 1994 to a record low in 1996 nearly equal to $F_{0.1}$. SSB reached a record low in 1994 and remains near that level in 1996. Recruiting year classes continue to decline in size, with the most recent (1994-1996) being the lowest on record.

At the present exploitation rate, given the probable level of recruitment, SSB is expected to increase each year through 1999. Maintaining this level of exploitation, given average recruitment, presents an opportunity to rebuild the stock.

Georges Bank Haddock

The stock is at a low biomass level and is overexploited. Fishing mortality has declined to below $F_{0.1}$ in 1996. Although SSB has increased from record-low levels due to growth of conserved year classes, stock numbers have not increased since 1994. The 1992 year class, though large relative to recent recruitment, is only one-third of the average observed during a period of sustained landings during 1935-1960. The 1994-1996 year classes appear moderate relative to others in the assessment time series, but are far below historic average levels when the stock was in a healthy condition.

Short-term projections indicate that SSB will increase slightly by 1999 if fishing mortality (F) in 1998 is held at the 1996 level. If F in 1998 increases to $F_{0.1}$, SSB will decrease slightly by 1999. If F in 1998 increases to $F_{30\%}$ (overfishing definition), SSB will decrease sharply between 1998 and 1999. Medium-term projections suggest that fishing at the current F level would result in a 52% chance of reaching or exceeding the SSB threshold by 2006.

Observed increases in SSB have resulted from conserving existing recruitment, a necessary first step in the stock rebuilding process. Significant rebuilding beyond current stock levels will require improved recruitment above levels observed in the past decade. To date, there are no indications in the survey data to suggest that recruitment has improved above these levels. Substantial stock rebuilding will be achieved only when significant and consistent improvement in recruitment is realized. Until then, restrictive management practices will continue to be necessary to maintain fishing mortality rates at very low levels.

Georges Bank Yellowtail Flounder

Although SSB has doubled in the last two years and is currently slightly above the biomass threshold, it remains low relative to historic levels. Fishing mortality dropped sharply in 1995 and declined further in 1996 to below the $F_{0.1}$ reference level. The 1990-1994 cohorts were moderately abundant, but the 1995 cohort was the weakest since 1986.

Projections suggest that landings and SSB will both continue to increase in the next three years if fishing mortality is maintained at or below the $F_{0.1}$ level.

Southern New England Yellowtail Flounder

Results of assessment analyses indicate that stock abundance was still very low in 1996, although there appears to be an increasing trend. Fishing mortality declined sharply in 1995 and decreased further to well below the $F_{0.1}$ reference point in 1996.

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 1994 and possibly the 1996 cohorts are moderately larger than the 1990-1993 and 1995 cohorts, but are small in comparison to the average year class size during 1973-1988.

The age structure of this stock was severely truncated during 1970-1994, but there is some indication that this trend may have been reversed and stock age structure may be improving.

Forecasts indicate that SSB will continue to improve slowly during 1997-1999 if fishing mortality is kept at or below the $F_{0.1}$ level.

## Conclusions of the SAW Steering Committee

The SAW Steering Committee met once during the SAW-24 cycle. A teleconference was held April 18, 1997 to discuss an issue paper prepared by Dr. Anderson, the SAW Chairman, on modifying the SAW process to meet changing expectations including a possible coast-wide assessment and peer-review process, receive a brief update on surfclam research, and consider the agendas for SAW-25 and SAW-26. A summary of this meeting 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 |

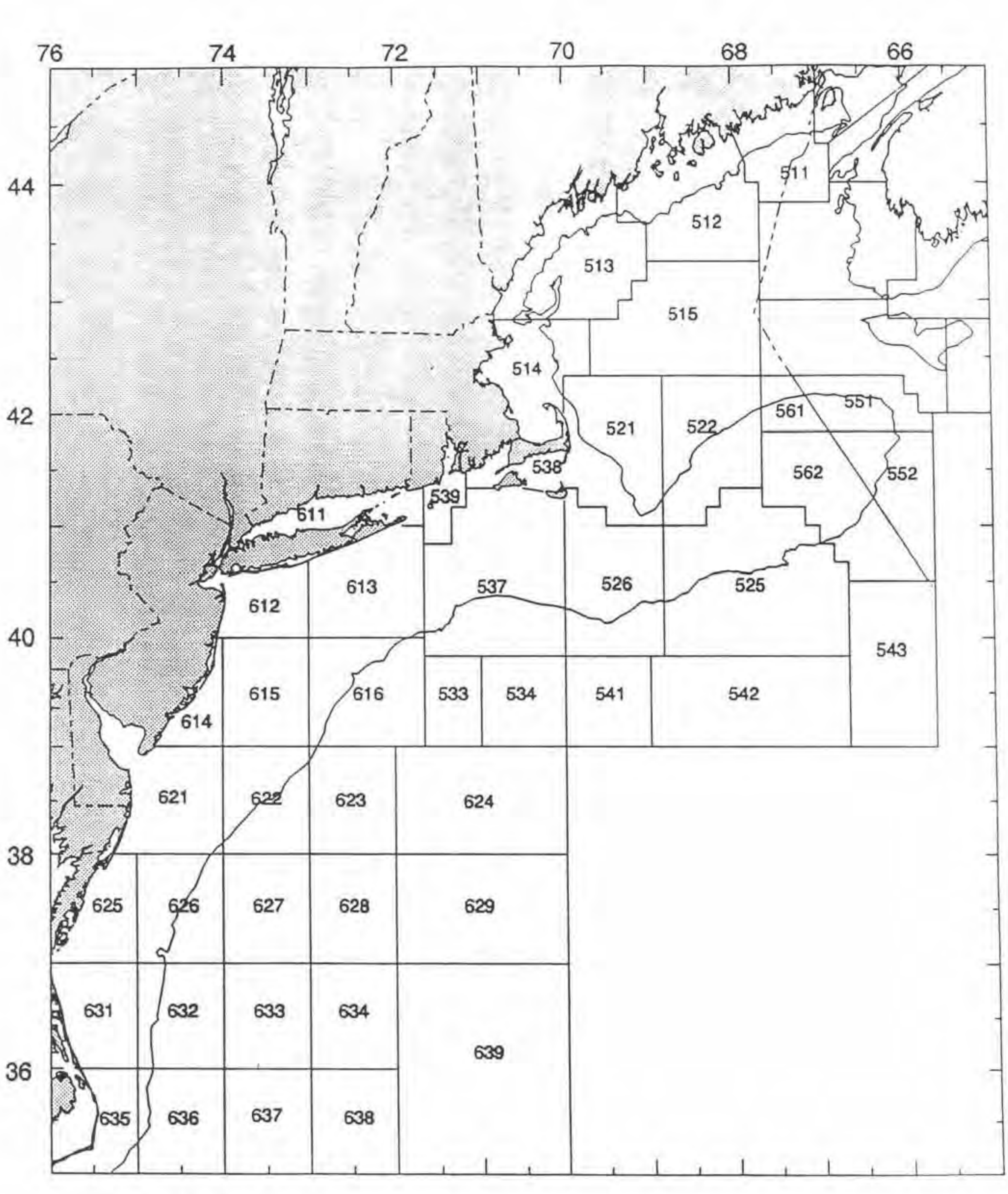



Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

**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).

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

**$F_{10\%}$:** The fishing mortality rate which reduces the spawning stock biomass per recruit to 10% of the amount present in the absence of fishing.

**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 rate of fishing mortality 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, rate of growth, and natural mortality rate, all of 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 (F) mortality rates and the natural (M) mortality rate for the species considered in this report.

| F | M = 0.20 | F | M = 0.20 |
|---|---|---|---|
| 0.1 | 9 | 1.1 | 62 |
| 0.2 | 16 | 1.2 | 65 |
| 0.3 | 24 | 1.3 | 67 |
| 0.4 | 30 | 1.4 | 70 |
| 0.5 | 36 | 1.5 | 72 |
| 0.6 | 41 | 1.6 | 74 |
| 0.7 | 46 | 1.7 | 76 |
| 0.8 | 51 | 1.8 | 78 |
| 0.9 | 55 | 1.9 | 79 |
| 1.0 | 58 | 2.0 | 81 |

## ADVISORY OVERVIEW

The five stocks for which stock status summaries and management advice are provided in the following sections (i.e., Gulf of Maine cod, Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, and Southern New England yellowtail flounder) have traditionally been the most important in the New England groundfish fishery and constitute the predominant focus of the regulatory measures contained in the New England Fishery Management Council's Northeast Multispecies Fishery Management Plan (FMP). SAW-24 represents one of the few occasions when all five stocks have been formally assessed at the same time. These five stocks are closely related in the fishery. The Georges Bank stocks are caught together, either as target species or bycatch. Many of the vessels in the fishery have switched or could switch fishing grounds between the Gulf of Maine, Georges Bank, and Southern New England regions. The fisheries management approach for the five stocks is similar, which is at least partially responsible for the similarities in their status. Therefore, the SARC decided to highlight the overall status of the stocks as indicated in the following summary statements, Table 2 and Figure 2.

- The situation for Georges Bank cod, Georges Bank haddock, Georges Bank yellowtail flounder, and Southern New England yellowtail flounder has recently improved (Figure 2), but the situation for Gulf of Maine cod remains essentially unchanged, and the risk of further deterioration is a serious concern.

- Except for Gulf of Maine cod, fishing mortality for the assessed stocks has been reduced below the level of overfishing reference points established in the FMP and is near or below the target fishing mortality levels set for rebuilding the stocks.

- Except for Gulf of Maine cod, there has been some rebuilding of the spawning stock biomass of the assessed stocks, and one stock has rebuilt to near the spawning stock biomass threshold level established in the FMP, but spawning stock biomass remains low relative to historical levels that are probably necessary to produce MSY.

- Recruitment in recent years remains low relative to historical levels for most of the assessed stocks.

- Short-term projections at current fishing mortality rates indicate that levels of spawning stock biomass will be maintained or continue to rebuild at a modest rate, except for Gulf of Maine cod for which the projections indicate a further decline.

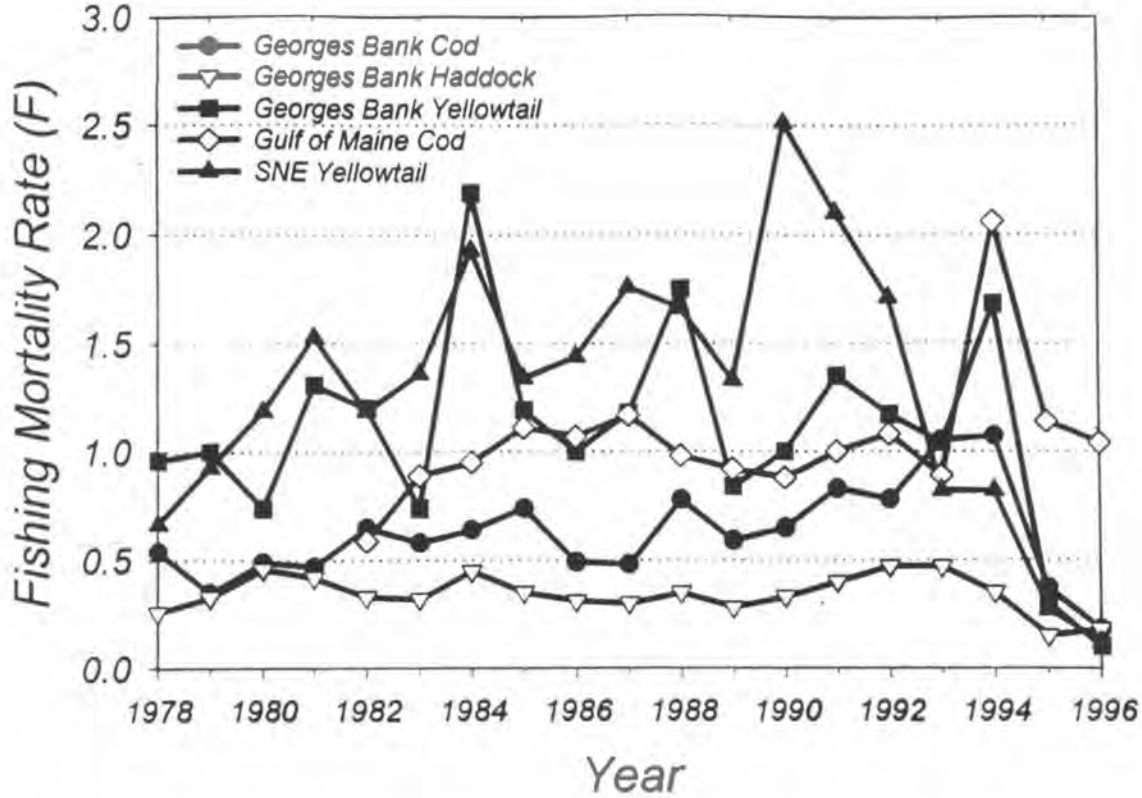
- The situation for Gulf of Maine cod, which is much worse than for the other assessed stocks, warrants strong management measures to sharply reduce fishing mortality and reduce the very high risk of stock collapse.

- Although the situation has improved for four of the assessed stocks, as noted above, continued rebuilding and the potential of substantially higher sustainable yields (i.e., MSY) will be jeopardized if the fishing mortality rates are allowed to increase. Thus, efforts to reduce the fishing mortality on Gulf of Maine cod should not come at the expense of other groundfish stocks and other heavily exploited stocks either in or outside of the Gulf of Maine.

The remainder of this Advisory Report gives more detailed information on the status of each of the five stocks assessed at SAW-24. Much of this information is in the form of quantitative output of analyses and models. The SARC reviewed the input data, model assumptions, and analytical methods employed by the joint Northern Demersal and Southern Demersal Working Group in performing these assessments and had numerous suggestions and recommendations for improvements (which it usually does when reviewing any stock assessments). These are discussed in the *SARC Consensus Summary of Assessments* report. These suggestions and recommendations would undoubtedly have resulted in some quantitative changes in the assessment results. But since it was not practical to implement these suggestions and recommendations in a timely manner given the schedule for completing and reviewing the assessments, it was necessary for the SARC to judge the adequacy of the existing assessment outputs for the purpose of providing management advice. The **SARC concluded that the assessments generally give a realistic indication of the status of the stocks and that the advice based on these assessments is robust (i.e., it is unlikely to have been different if the SARC's suggestions and recommendations for improving the assessments could have been implemented).**

**Table 2.** Summary of status of five New England groundfish stocks reviewed at SAW-24. The status of each stock is summarized in terms of current (1996) fishing mortality, 1994-1996 recruitment, 1994-1996 spawning stock biomass (SSB), and the minimum SSB thresholds established, for management purposes, in the Multispecies FMP. Fishing mortality in 1996 is characterized relative to the $F_{0.1}$ or $F_{max}$ (Gulf of Maine cod) rebuilding targets. Minimum spawning stock biomass thresholds were established for Georges Bank cod (70,000 mt), Georges Bank haddock (80,000 mt), Georges Bank yellowtail flounder (10,000 mt), and Southern New England yellowtail flounder (10,000 mt).

| Stock | Current fishing mortality | 1994-1996 recruitment | 1994-1996 SSB | Biomass threshold |
|---|---|---|---|---|
| Gulf of Maine cod | Well above target | Low | Low/declining | Threshold not defined |
| Georges Bank cod | Near target | Low | Low/increasing | Well below |
| Georges Bank haddock | Below target | Low | Low/increasing | Well below |
| Georges Bank yellowtail flounder | Below target | Average | Low/increasing | Near |
| Southern New England yellowtail flounder | Below target | Low | Low/increasing | Below |



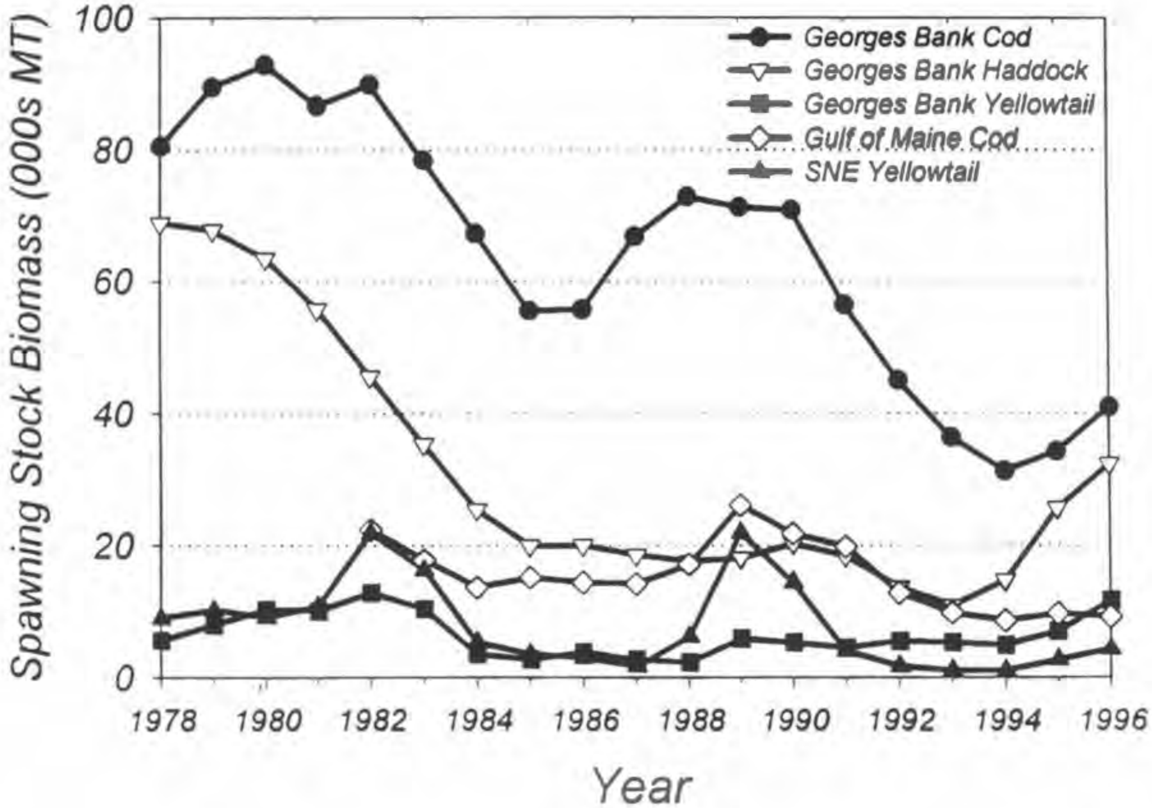




Figure 2. Fishing mortality (fully-recruited; above) and spawning stock biomass (below) for five New England groundfish stocks.

## A. GULF OF MAINE COD ADVISORY REPORT

**State of Stock:** This stock continues to be over-exploited and biomass remains at a very low level. Two successive year classes (1994 and 1995) which recruited to the fishery in 1996 and 1997 are the lowest ever observed. Fishing mortality has been very high (in excess of F = 0.88 or 54% exploitation) since 1983, while spawning stock biomass continues to decline to new record lows. In addition, 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. Accounting for the uncertainty associated with the 1996 F and SSB estimates, there is an 80% probability that the 1996 SSB lies between 7,800 t and 11,300 t (Figure A6), and that the 1996 F lies between 0.79 (50% exploitation) and 1.41 (70% exploitation) (Figure A5). This further implies a 90% probability that the 1996 F was greater than 0.79 (50% exploitation), or about two times greater than the overfishing definition ($F_{20\%}$ = 0.37 or 28% exploitation) and almost three times the rebuilding level ($F_{max}$ = 0.29 or 23% exploitation).

**Management Advice:** The combined effects of low spawning stock biomass, high fishing mortality, record low incoming recruitment, and record low survival of pre-recruit fish indicate that the stock is on the verge of collapse. If the fishing mortality rate in 1997 continues at the 1996 level, the spawning biomass is expected to decline to an unprecedented low level in 1998. An immediate reduction in fishing mortality to levels approaching zero is required to halt the declining trend in spawning stock biomass and to rebuild at the maximum rate possible. Measures should be enacted immediately to minimize all directed fishing and bycatch on this stock.

**Forecast for 1997-1999:** The forecasts were performed assuming that fishing mortality in 1997 was the same as in 1996 (i.e., F = 1.04 or 60% exploitation). This fishing mortality rate implies that commercial landings in 1997 will be about 5,800 mt and the SSB at the beginning of 1998 will be less than 5,000 mt.

**Forecast Table:** $F_{97}$ = 1.04, Basis: 1996 F point estimate from tuned VPA. Recruitment (age 2) of the 1996 and 1997 year classes derived by resampling the distribution of empirical recruitment of the 1988-1994 year classes (median = 3.1 million). SSB was estimated to be 9,200 mt in 1996 and 6,900 mt in 1997 (weights in '000 t).

| Option | 1997 | | 1998 | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|
| | Landings | SSB | Landings | SSB | SSB | |
| F = 0.00 | 5.8 | 6.9 | 0.0 | 5.5 | 9.5 | SSB in 1999 increases slightly above 1996 level; landings prohibited |
| $F_{0.1}$ = 0.16 | 5.8 | 6.9 | 0.8 | 5.4 | 8.3 | SSB in 1999 remains below 1996 level; landings decline to record low |
| $F_{max}$ = 0.29 | 5.8 | 6.9 | 1.4 | 5.3 | 7.4 | SSB in 1999 remains below 1996 level; landings decline to record low |
| $F_{20\%}$ = 0.37 | 5.8 | 6.9 | 1.8 | 5.2 | 6.9 | SSB in 1999 remains below 1996 level; landings decline to record low |
| $F_{96}$ = 1.04 | 5.8 | 6.9 | 3.9 | 4.8 | 4.3 | SSB in 1999 declines precipitously to new record low |

Continued fishing at current levels of fishing mortality (i.e., F = 1.04) will lead to landings in 1998 declining to their lowest level since 1965. SSB in 1999 will decline to an unprecedented record-low level.

**Medium-Term Projections:** Medium-term (10-year) projections were revised for the purpose of comparing the effects of different fishing mortality rate strategies. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1), and landings are given in Figure A8 for fishing mortality rate scenarios of F = 0.00, 0.29, and 1.04.

Projected landings under $F_{96}$ = 1.04 decline steadily from 3,200 mt in 1999 to 1,500 mt in 2006. Spawning stock biomass declines from 4,800 mt in 1999 to 2,000 mt in 2006, while recruitment declines from 1.1 to 0.5 million fish at age 1 (0.9 to 0.4 million at age 2) over the same period. Under the $F_{max}$ = 0.29 scenario, landings rise steadily from 3,100 mt in 1999 to about 11,000 mt in 2006, while spawning stock biomass improves from 12,300 mt to 44,000 mt and recruitment from 2.4 to 7.4 million (2.0 to 6.1 million at age 2) during 1999-2006. For F = 0.00, spawning stock biomass increases 6-fold from 19,800 mt in 1999 to about 120,000 mt in 2006, while median recruitment improves from 4.3 to 14.0 million fish (3.5 to 11.5 million at age 2).

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

| Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Max[1] | Min[1] | Mean[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US commercial landings | 10.4 | 15.2 | 17.8 | 10.9 | 8.3 | 7.9 | 6.8 | 7.2 | 17.8 | 6.8 | 10.6 |
| Otter trawl | 6.2 | 10.4 | 13.0 | 7.3 | 4.9 | 4.2 | 3.5 | 4.0 | 13.0 | 3.5 | 6.8 |
| Sink gillnet | 4.0 | 4.4 | 4.2 | 3.1 | 3.1 | 3.3 | 3.1 | 2.8 | 4.4 | 2.7 | 3.4 |
| Handline/line trawl | 0.1 | 0.2 | 0.3 | 0.5 | 0.3 | 0.3 | 0.3 | 0.3 | 0.5 | <0.1 | 0.2 |
| Other gear | 0.1 | 0.2 | 0.3 | <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 | 10.4 | 15.2 | 17.8 | 10.9 | 8.3 | 7.9 | 6.8 | 7.2 | 17.8 | 6.8 | 10.6 |
| Discards[2] | 1.5 | 3.6 | 1.1 | 0.6 | 0.3 | 0.2 | 0.4 | 0.2 | [3]3.6 | [3]0.2 | [3]1.0 |
| US recreational landings[2] | 1.8 | 2.8 | 2.9 | 0.6 | 1.2 | 0.9 | 0.8 | 0.9 | 2.9 | 0.6 | 1.5 |
| Catch used in assessment | 10.4 | 15.2 | 17.8 | 10.9 | 8.3 | 7.9 | 6.8 | 7.2 | 17.8 | 6.8 | 10.6 |
| Spawning stock biomass[4] | 26.1 | 21.8 | 19.8 | 12.8 | 9.8 | 8.6 | 9.7 | 9.2 | 26.1 | 8.6 | 15.5 |
| Recruitment (age 2) | 17.7 | 2.8 | 2.8 | 4.8 | 4.3 | 6.4 | 3.1 | 1.0 | 17.7 | 1.0 | [5]4.7 |
| F (ages 4-5) | 0.92 | 0.88 | 1.00 | 1.08 | 0.89 | 2.06 | 1.14 | 1.04 | 2.06 | 0.60 | 1.05 |
| Exploitation rate | 55% | 54% | 58% | 61% | 54% | 82% | 63% | 60% | 82% | 41% | 60% |

[1]Over period 1982-1996. [2]Not used in final assessment, but recreational data used in secondary VPA. [3]Over period 1989-1996. [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 A1). Total commercial landings in 1996 were 7,230 mt and are expected to decline to 5,000 - 6,000 mt in 1997. 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. A secondary assessment was performed which included recreational catches in the VPA. The precision and uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1996 were quantitatively evaluated. In addition, an alternative assessment utilizing a different model corroborated the original VPA results.

**Biological Reference Points**: Yield and SSB per recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1}$ (0.16 or 13% exploitation), $F_{max}$ (0.29 or 23% exploitation), and $F_{20\%}$ (0.37 or 28% exploitation) (Figure A3). The latter two reference points are higher than previous estimates because of a decreased exploitation pattern on younger fish.

**Fishing Mortality:** Fishing mortality has been very high (in excess of F = 0.88 or 54% exploitation) since 1983 (Figure A1) and far in excess of $F_{max}$, the current rebuilding objective. Current fishing mortality remains at about 1.0 (58% exploitation).

**Recruitment:** The 1987 year class was the strongest during the assessment period, although the 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 and 1995) are by far the poorest in the VPA time series, averaging less than 1 million age 2 fish (Figure A2). In addition, survival ratios (R/SSB) have been declining over the last four years and are now at an all time low.

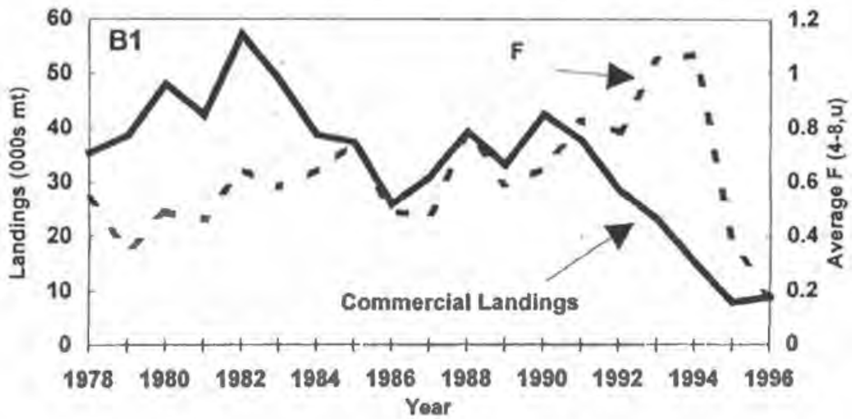
**Spawning Stock Biomass:** SSB declined by nearly 40% between 1982 and 1987 (22,400 mt to 14,100 mt), increased to a relatively high level in 1989 of 26,100 mt, due to recruitment of the strong 1987 year class to the spawning stock, but fell to a record low level of 8,600 mt in 1994 and has remained low in 1995 and 1996 (Figure A2). Survey data (Figure A7) suggest that SSB has declined by 80% since the early 1960s.

**Special Comments:** A sensitivity analysis was performed that included recreational landings in the catch-at-age data. Inclusion of the recreational data in the analysis did not alter the overall trends in fishing mortality and stock biomass.

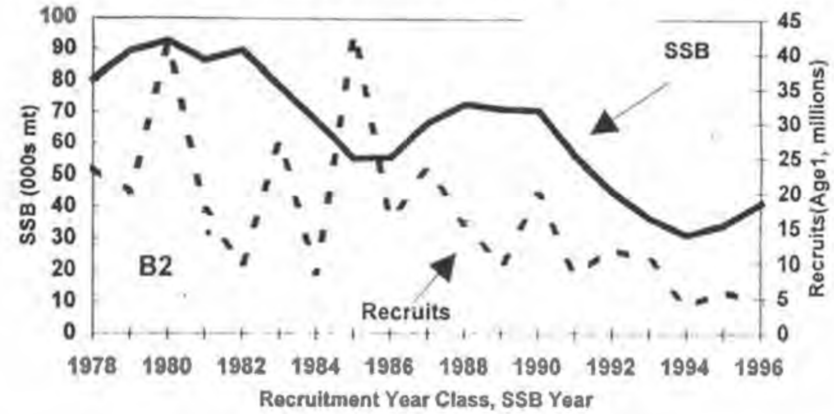
**Source of Information:** Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 97-xx; R.K. Mayo, Assessment of the Gulf of Maine cod stock for 1997, NEFSC Ref. Doc. 97-xx; J. Ianelli, An alternative stock assessment analysis for Gulf of Maine cod, NEFSC Ref. Doc. 97-xx.

# Georges Bank Cod

### Trends in Commercial Landings and Fishing Mortality

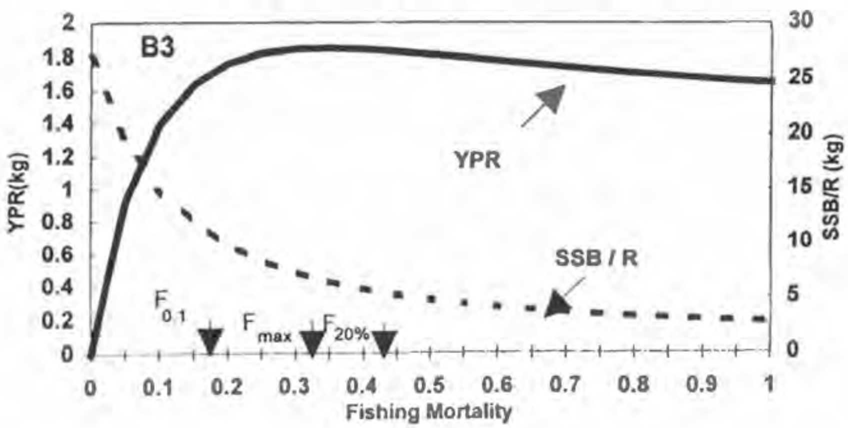



### Trends in Spawning Stock Biomass and Recruitment

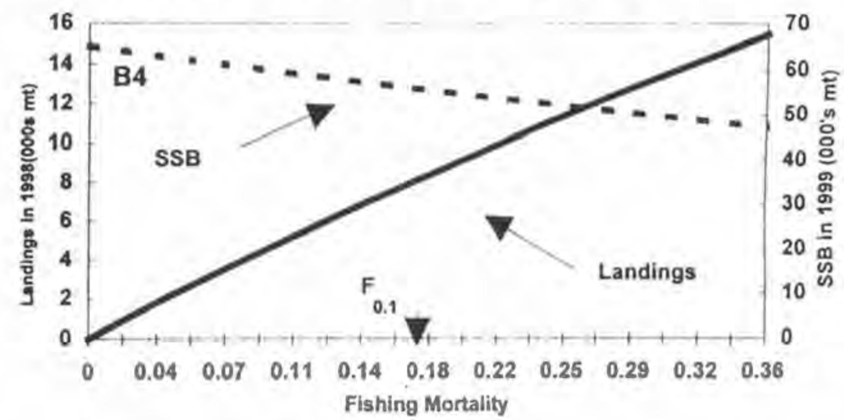





### Yield and Spawning Stock Biomass per Recruit

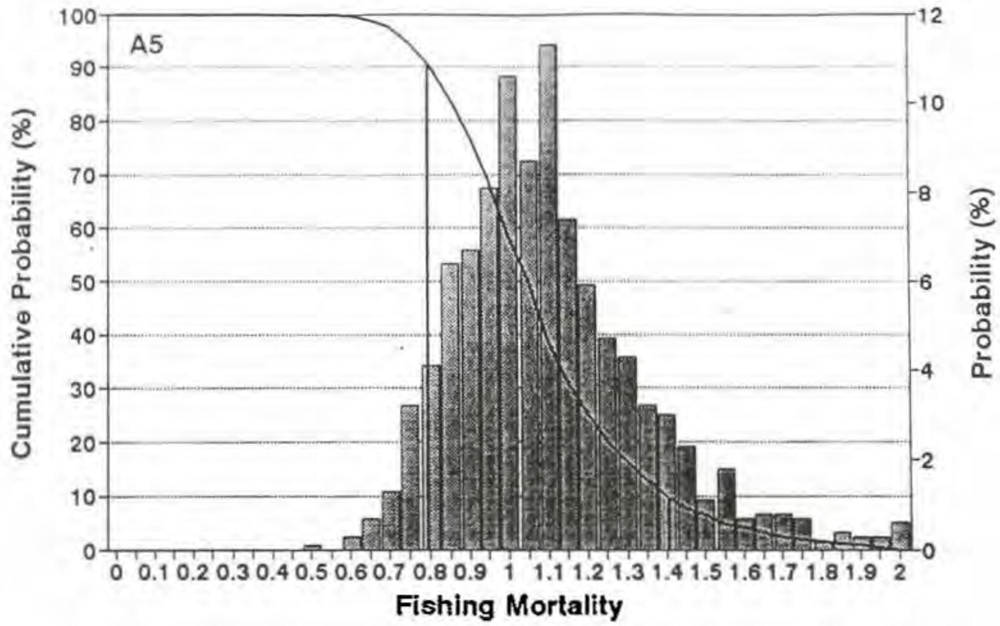



### Short-Term Landings and SSB (Average 1991-1997 Recruitment)

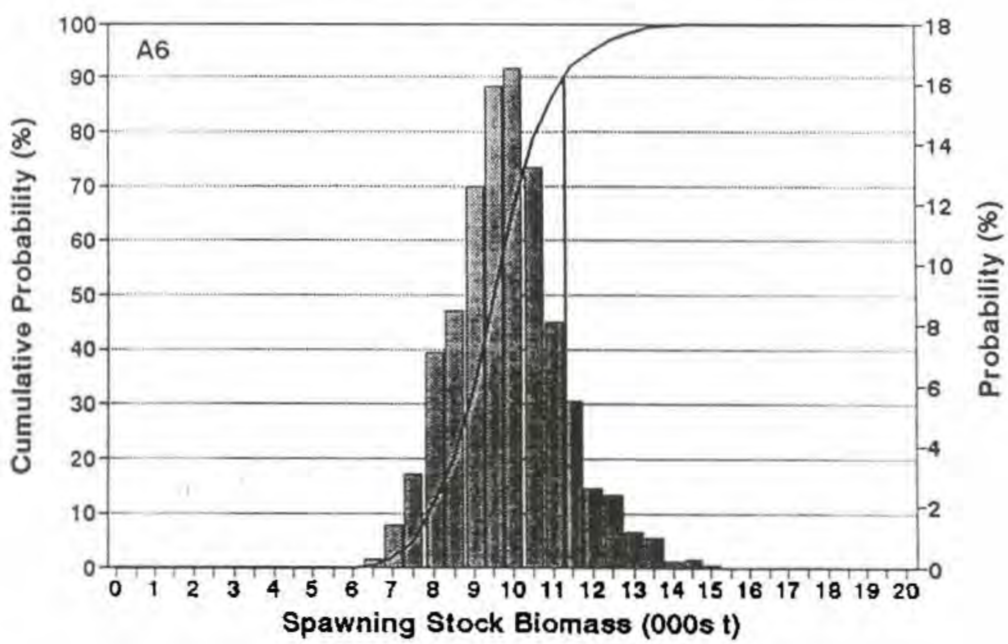


# Gulf of Maine Cod

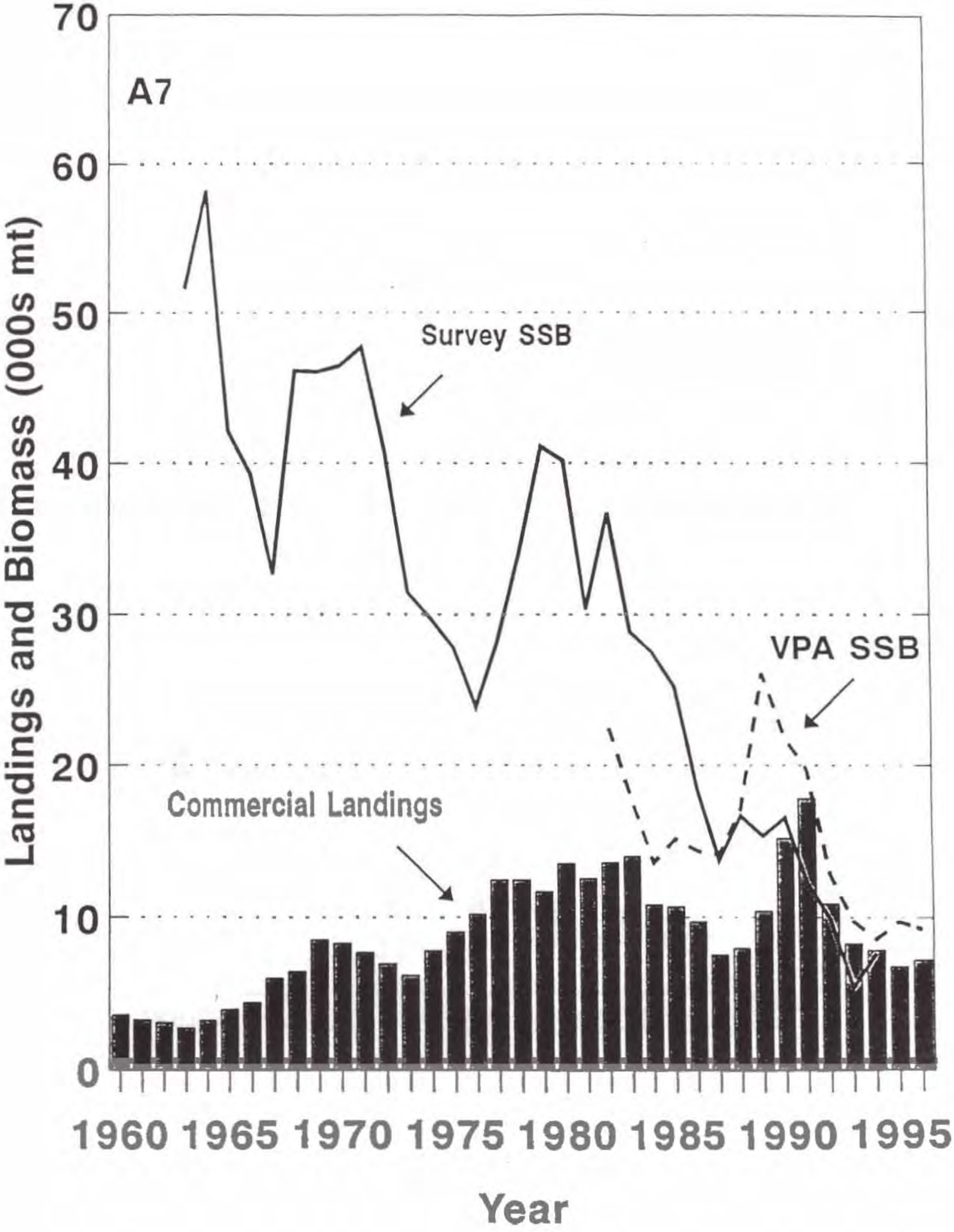
## Precision of 1996 F Estimate




## Precision of 1996 SSB Estimate



# *Trends in Landings and Survey-Based SSB*



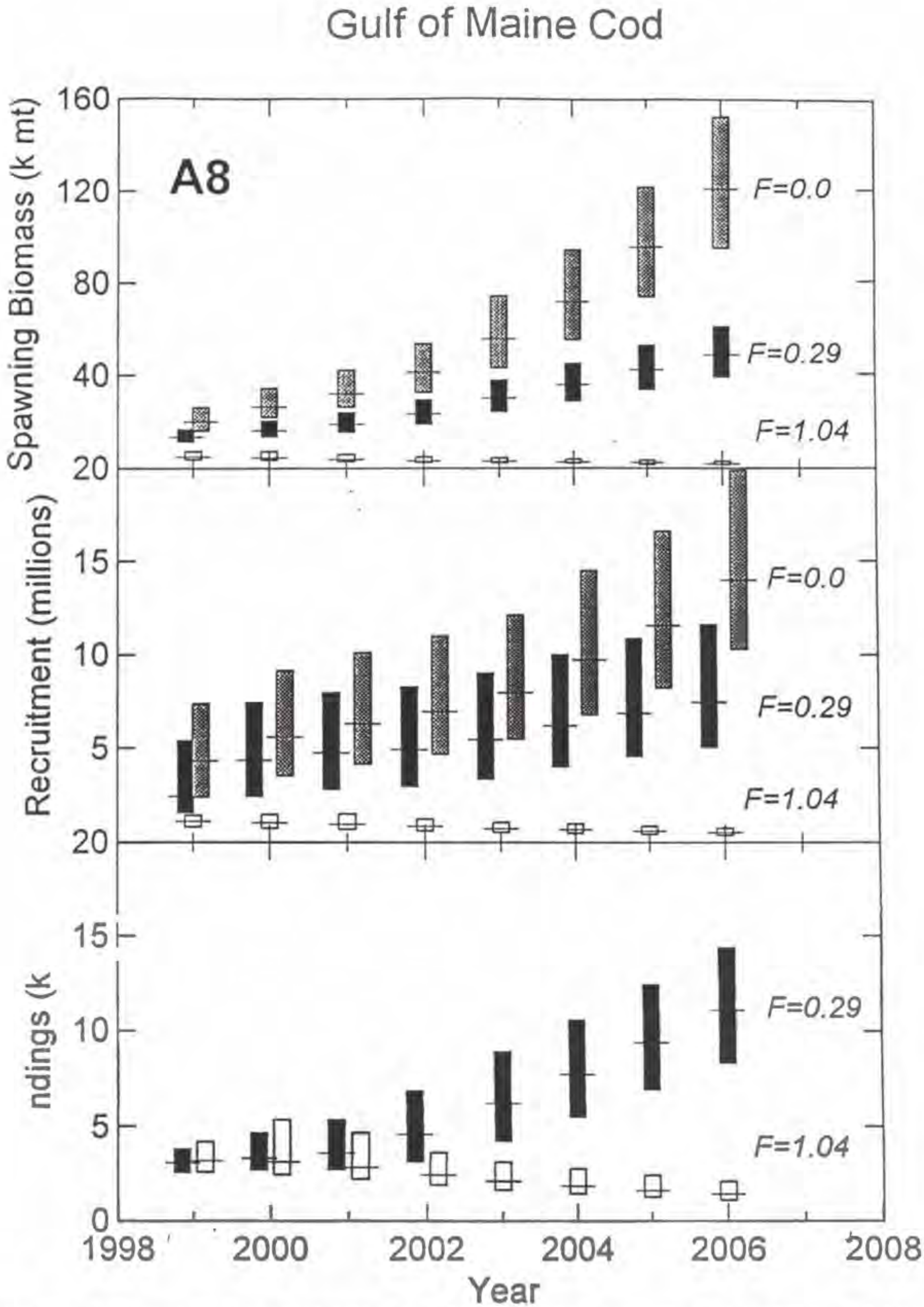



Figure A8. Results of medium-term projections for Gulf of Maine cod under three different fishing mortality rate scenarios (F = 1.04, 0.29, and 0.00). Annual spawning stock biomass, recruitment, and landings data are given. Horizontal bars are the median values from bootstrap results, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

## B. GEORGES BANK COD ADVISORY REPORT

**State of Stock:** The stock is at a low biomass level and is in an over-exploited state. Fishing mortality declined from a record high of 1.07 (61% exploitation) in 1994 to a record low during assessment period of 0.18 (15% exploitation) in 1996 (Figure B1). Spawning stock biomass has increased from the time series low in 1994. Despite this initial rebuilding due to growth and decreased fishing mortality (Figure B2), there is nearly a 100% probability that spawning stock biomass in 1996 was less than 70,000 t (Figure B6), the Amendment 7 minimum threshold. The sizes of recruiting year classes continue to decline, with the most recent year classes (1994, 1995, and 1996) being the lowest during the assessment period. Assuming that the 1996 fishing mortality rate is maintained in 1997, landings in 1997 will remain at a low level.

**Management Advice:** Fishing mortality on this stock should not increase. Continued exploitation at the current fishing mortality rate will result in an estimated total catch in 1998 of about 8,000 mt. Increases in SSB are predicated on low fishing mortality and average recruitment. The most recent average year class occurred in 1990. Maintaining fishing mortality at the 1996 level presents an opportunity to increase the SSB primarily by growth of the 1992 and 1993 year classes which is particularly important given the poor recruitment after 1993.

**Forecast for 1997-1999:** The forecasts for 1997-1999 (Figure B4) were based on the VPA-calibrated 1996 stock sizes. Projections were performed only for $F_{0.1} = 0.17$ (14% exploitation). Recruitment was estimated as the geometric mean of the 1990-1996 year classes (. F in 1997 was assumed to be the same as in 1996, with resulting landings of 7,860 mt and an SSB of 46,400 mt.

**Forecast Table:** $F_{97} = 0.18$, Basis: $F_{96}$ from calibrated VPA, SSB estimated to be 46,400 mt in 1997, long-term average SSB is 64,000 mt (weights in '000 mt).

| Option | 1997 | | 1998 | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|
| | Landings | SSB | Landings | SSB | SSB | |
| $F_{0.1} = 0.17$ | 7.9 | 46.4 | 7.9 | 50.9 | 55.9 | SSB in 1999 increases to nearly 90% of the long-term average; landings remain at current record low levels |

**Medium-Term Projections:** Medium-term (10-year) projections were revised. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1) and landings are given in Figure B7 for the fishing mortality rate scenario of $F = 0.17$ (separate scenarios were not undertaken for $F_{0.1} = 0.17$ and $F_{96} = 0.18$ since the results are essentially the same). The annual probability that SSB exceeds the threshold value of 70,000 mt is given in Figure B8.

Under the $F_{0.1} = 0.17$ scenario, landings rise steadily from 9,000 mt in 1999 to about 30,000 mt in 2006, while spawning stock biomass improves from 62,000 mt to 200,000 mt and median recruitment from 15.4 to 34.4 million fish during 1999-2006. The probability that SSB exceeds the 70,000 mt threshold increases steadily from 20% in 1999 to >99% by 2002 and beyond (Figure B8).

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

| Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Max[3] | Min[3] | Mean[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total commercial landings | 33.1 | 42.5 | 37.6 | 28.6 | 23.1 | 15.2 | 7.9 | 8.9 | 57.2 | 7.9 | 33.6 |
| US commercial landings | 25.1 | 28.2 | 24.2 | 16.9 | 14.6 | 9.9 | 6.8 | 7.0 | 40.1 | 6.8 | 24.4 |
| Canada commercial landings | 8.0 | 14.3 | 13.5 | 11.7 | 8.5 | 5.3 | 1.1 | 1.9 | 17.8 | 1.1 | 9.2 |
| Discards | | Discards occur but reliable estimates not presently available | | | | | | | | | |
| US recreational landings[1] | 2.0 | 1.0 | 1.9 | 0.6 | 2.9 | 1.5 | 2.1 | 0.8 | 9.1 | 0.5 | 2.6 |
| Catch used in assessment | 33.1 | 42.5 | 37.6 | 28.6 | 23.1 | 15.2 | 7.9 | 8.9 | 7.2 | 7.9 | 33.6 |
| Spawning stock biomass[2] | 71.3 | 70.9 | 56.4 | 45.0 | 36.4 | 31.3 | 34.3 | 41.1 | 92.8 | 31.3 | 64.4 |
| Recruitment (age 1) | 15.7 | 9.7 | 19.8 | 8.7 | 12.0 | 10.7 | 4.0 | 6.1 | 42.9 | 4.0 | 18.2 |
| F (ages 4-8) | 0.59 | 0.65 | 0.83 | 0.78 | 1.05 | 1.07 | 0.37 | 0.18 | 1.07 | 0.18 | 0.62 |
| Exploitation rate | 41% | 44% | 52% | 50% | 60% | 61% | 28% | 15% | 61% | 15% | 42% |

[1]Not used in assessment. [2]At beginning of the spawning season (i.e., March 1). [3]Over period 1978-1996.

**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 B1). Total commercial landings have since declined to a record low of 7,900 mt in 1995, but then increased to 8,900 mt in 1996. Recreational catches have ranged from 500 mt to 9,100 mt and accounted for 1-19% of the total cod 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. A secondary assessment was performed which included recreational catches in the VPA. The uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1996 were evaluated (Figures B5 and B6).

**Biological Reference Points:** Yield and SSB per recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1}$ = 0.17 (14% exploitation), $F_{max}$ = 0.34 (26% exploitation) and $F_{20\%}$ = 0.43 (32% exploitation) (Figure B3). These reference points are higher than previous estimates because of a decreased exploitation pattern on younger fish.

**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 0.78 (50% exploitation) (Figure B1). F increased again in 1991 to 0.83 (52% exploitation) and peaked at a record high of 1.07 (61% exploitation) in 1994, and has since declined to 0.18 (15% exploitation) in 1996. There is a 70% probability that the F in 1996 exceeded $F_{0.1}$.

**Recruitment:** Strong year classes were produced in 1980, 1983, and 1985 (Figure B2). The 1990 year class was slightly above average, the 1992 year class was about average, but the 1994 and 1995 year classes are the lowest on record. The 1996 year class is also estimated to be poor.

**Spawning Stock Biomass:** SSB declined by about 50% between 1980 and 1985/1986 (92,800 mt to 56,000 mt), increased to 73,000 mt in 1988, but declined to 45,000 mt in 1992 before falling to a record low of 31,000 mt in 1994 (Figure B2). SSB increased to 41,000 mt in 1996 and is projected to increase in 1997. There is nearly 100% probability that SSB in 1996 was less than 70,000 mt.

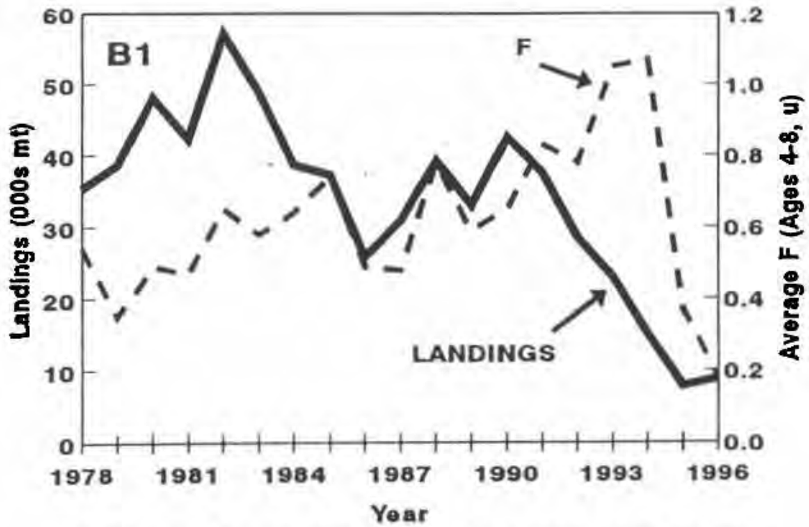
**Special Comments:** Lack of discard data in the assessment may result in an underestimate of F on the youngest ages, and lack of recreational catches in the assessment may affect all ages, although the extent is unknown. A sensitivity analysis was performed that included recreational landings in the catch-at-age data. Inclusion of the recreational data in the analysis did not alter the overall trends in fishing mortality and stock biomass.

The restrictive management measures implemented by Canada and the US in 1995 were effective in reducing mortality and initiating stock rebuilding. Within US waters, Georges Bank cod appears to have benifited from the closed areas, reduction in days at sea, and the restrictive haddock trip limit.

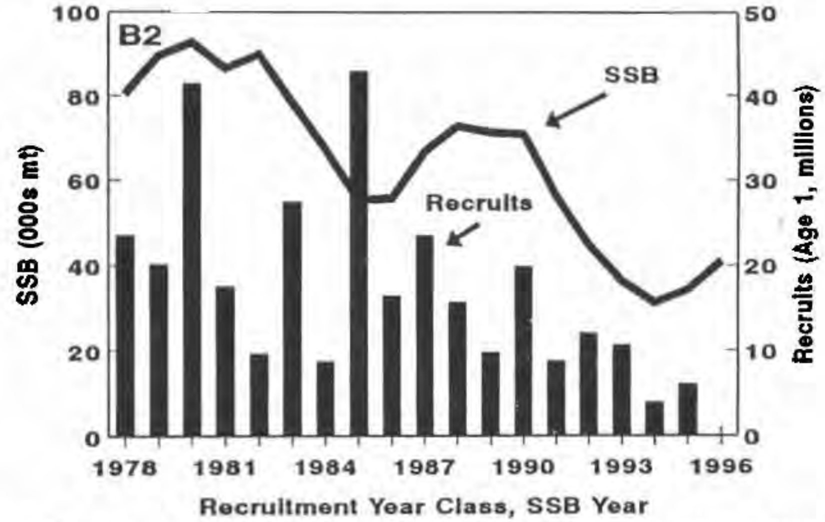
**Source of Information:** Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 97-xx; L. O'Brien, Assessment of the Georges Bank cod stock for 1997, NEFSC Ref. Doc. 97-xx).

# Georges Bank Cod

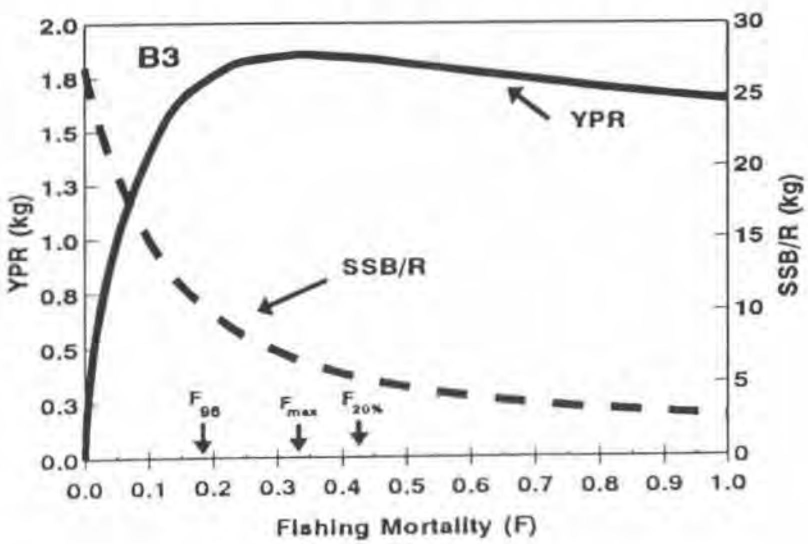
### Trends in Commercial Landings and Fishing Mortality



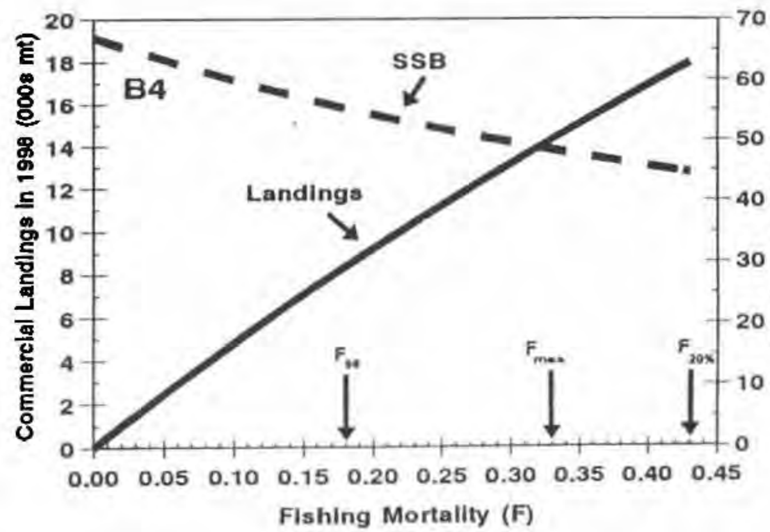

### Trends in Spawning Stock Biomass and Recruitment



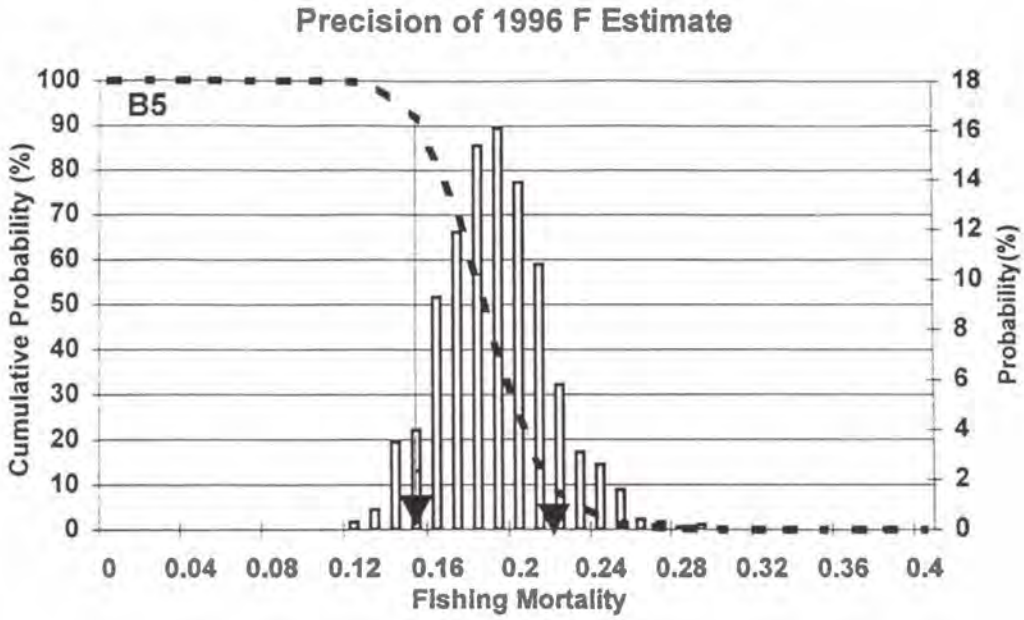

### Yield and Spawning Stock Biomass per Recruit

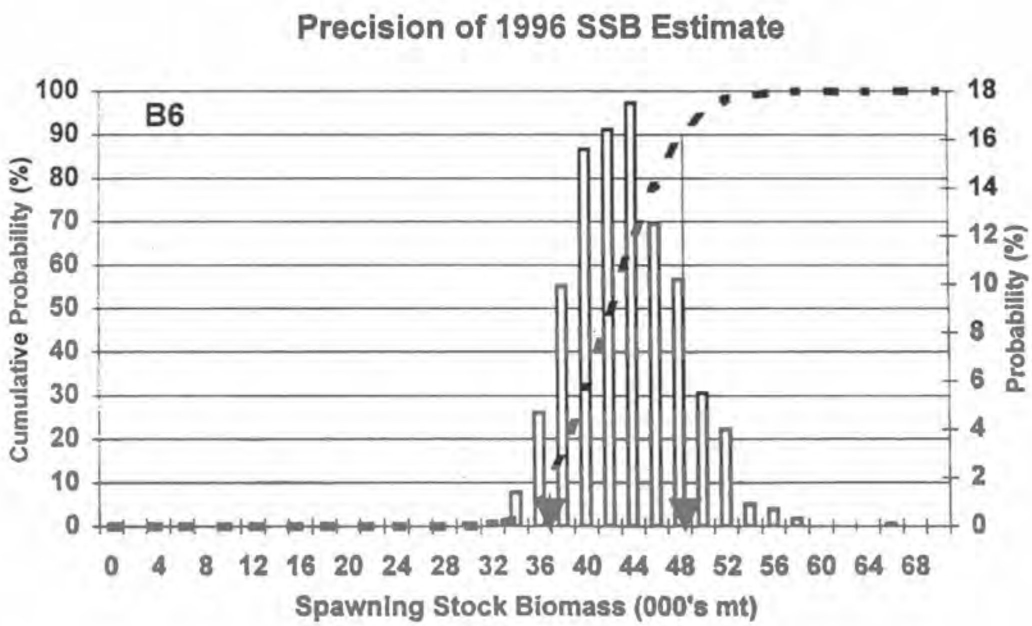



### Short-Term Commercial Landings and Spawning Stock Biomass



# Georges Bank Cod



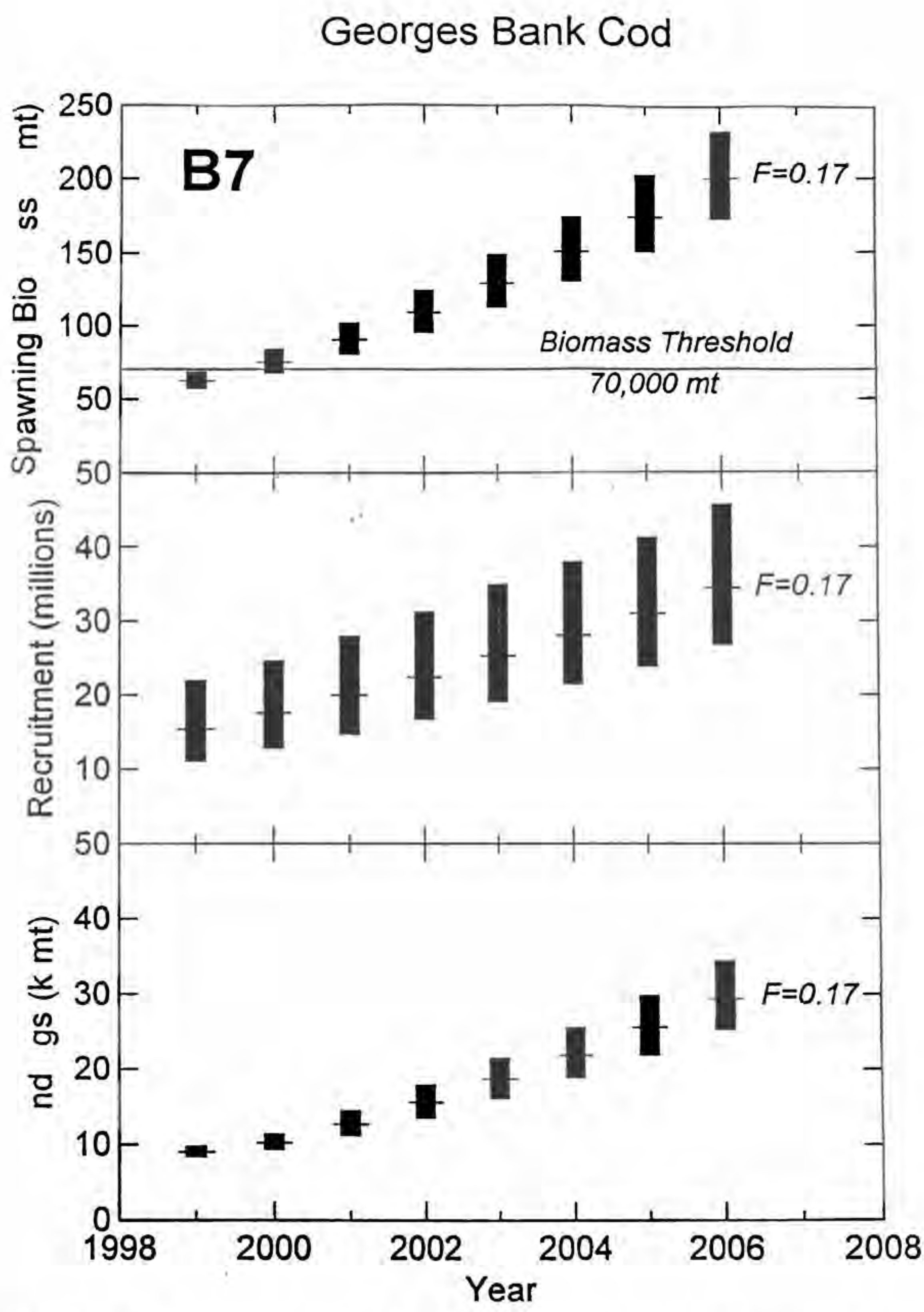



Figure B7. Results of medium-term projections for Georges Bank cod under a fishing mortality rate scenario of F = 0.17. Annual spawning stock biomass, recruitment, and landings data are given. Horizontal bars are the median values from bootstrap results, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile).

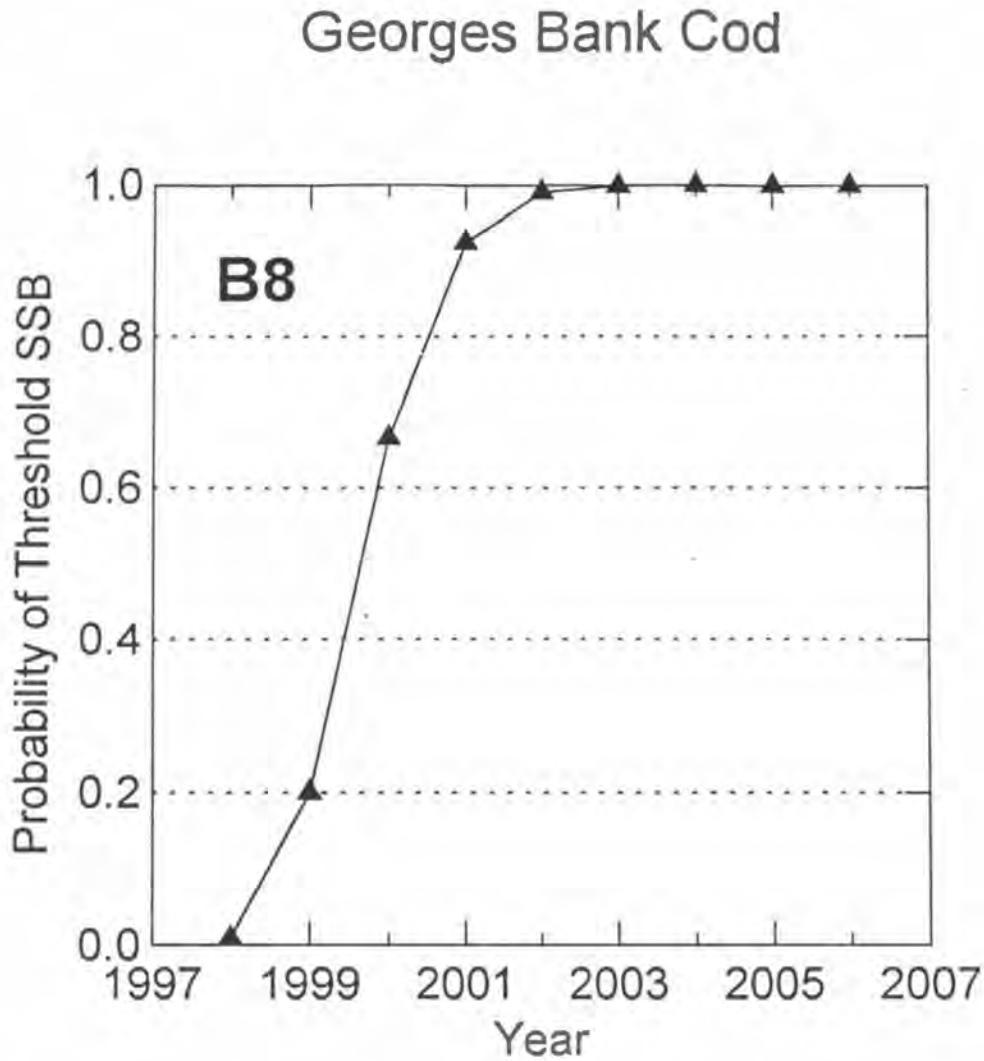



Figure B8. Annual probabilities of Georges Bank cod spawning stock biomass at or above 70,000 mt. Results are from medium-term stochastic projections.

## C. GEORGES BANK HADDOCK ADVISORY REPORT

**State of Stock:** This stock is at a low biomass level and is in an over-exploited state. Fishing mortality has been reduced and the 1996 estimate of F (0.18 or 15% exploitation) is below $F_{0.1}$ = 0.26 (21% exploitation). Although spawning stock biomass has increased from record low levels due to growth of conserved year classes, stock numbers have not increased since 1994. The 1996 spawning stock biomass may be overestimated by as much as 14% due to the influence of a single large tow in the 1996 US spring survey (see **Special Comments**). The 1992 year class, though it appears large in relation to recent recruitment, is only one-third of the average recruitment observed during a period of sustained landings from 1935-1960. Although the 1994-1996 year classes appear to be moderate compared to the assessment time series (Figure C2), this recruitment is far below average levels when the stock was in a healthy condition.

**Management Advice:** The stock continues to be well below the Amendment 7 biomass threshold of 80,000 mt. Continuation of restrictions on fishing mortality is needed to rebuild spawning stock biomass above the threshold level. Continuation of the current low fishing mortality rate will result in a broader size and age distribution in the spawning stock, increasing the probability of enhanced future recruitment.

Haddock resources in US waters are highly concentrated inside Closed Area I and, at times, in adjacent areas open to fishing. Continuation of existing year-round closed areas and possible expansion of Closed Area 1, or equivalent measures, are critical for promoting long-term stock rebuilding. While trip limit regulations have resulted in significant discards relative to landings, the regulations have been successful in eliminating incentives to target haddock concentrations. After liberalization of the haddock trip limit from 500 to 1,000 lb in July 1996, both landings and discards increased in the second half of 1996 and were significantly higher than in the same period in 1995 and the first half of 1996. If trip limit restrictions are further liberalized (as proposed for September 1997), additional restrictions may be required to offset potential increases in catchability resulting from targeting.

**Forecast for 1997-1999:** The forecasts (Figure C4) were performed assuming that the fishing mortality in 1997 was the same as in 1996 (i.e., F = 0.18 or 15% exploitation).

**Forecast Table:** Basis: $F_{97}$ = 0.18, with an associated catch of 5,500 mt. SSB in 1997 was estimated to be 38,340 mt. Recruitment (age 1) of the 1996 year class was estimated from the terminal year estimate. Recruitment (age 1) of the 1997 and 1998 year classes was estimated as the median of observed age 1 recruitment from the 1979-1996 year classes.(weights in '000 mt).

| Option | 1997 | | 1998 | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|
| | Landings | SSB | Landings | SSB | SSB | |
| $F_{96}$ = 0.18 | 5.5 | 38.3 | 5.8 | 39.8 | 40.7 | SSB increases slightly in 1999, US/Canada catch increases slightly |
| $F_{0.1}$ = 0.26 | 5.5[1] | 38.3[1] | 8.1 | 39.3 | 38.0 | SSB stabilizes in 1999, US/Canada catch increases about 50% |

[1]Assuming $F_{97} = F_{96}$.

**Medium-Term Projections:** Medium-term (10-year) projections were revised for the purpose of comparing the effects of different fishing mortality rate strategies. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1), and landings are given in Figure

C7 for fishing mortality rate scenarios of F = 0.10, 0.18, and 0.26. The annual probability that SSB exceeds the 80,000 mt threshold is plotted for the various F scenarios in Figure C8.

Under the $F_{0.1}$ = 0.26 scenario, landings increase from 8,100 mt in 1999 to 12,900 mt in 2006, while spawning stock biomass improves from 40,800 mt to 65,400 mt and recruitment from 8.7 to 10.7 million fish from 1999 to 2006. For F = 0.18, landings increase from 6,400 mt in 1999 to 11,600 mt, while spawning stock biomass increases from 45,100 mt in 1999 to 82,000 mt in 2006, and median recruitment improves from 9.2 to 11.7 million fish. With F = 0.10, landings rise from 4,100 mt in 1999 to 8,600 mt in 2006, spawning stock biomass increases from 50,000 mt to 104,700 mt, and recruitment improves from 9.7 to 13.2 million. Under the F = 0.26 scenario, the probability of exceeding the biomass threshold increases from 0.3% in 1999 to 38% by 2006. For F = 0.18, the annual probability of SSB exceeding the 80,000 mt threshold increases from 0.5% in 1999 to 52% by 2006. If F is reduced to 0.10, the annual probability of SSB exceeding the threshold increases from 1.2% in 1999 to 68% by 2006 (Figure C8).

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

| Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Max[1] | Min[1] | Mean[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US commercial landings | 1.4 | 2.0 | 1.4 | 2.0 | 0.7 | 0.2 | 0.2 | 0.3 | 52.9 | 0.2 | 11.6 |
| Otter trawl | 1.4 | 1.9 | 1.3 | 2.0 | 0.7 | 0.2 | 0.1 | 0.2 | 52.0 | 0.1 | 11.3 |
| Longline | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | <0.1 | 1.1 | <0.1 | 0.3 |
| 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 | 3.1 | 3.3 | 5.4 | 4.1 | 3.7 | 2.4 | 2.1 | 3.7 | 18.3 | 0.5 | 5.1 |
| Otter trawl | 2.0 | 2.4 | 4.0 | 2.6 | 2.5 | 1.6 | 1.6 | 2.7 | 17.9 | 0.4 | 4.5 |
| Longline | 1.0 | 0.9 | 1.3 | 1.4 | 1.1 | 0.7 | 0.4 | 0.9 | 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 | 4.5 | 5.3 | 6.8 | 6.1 | 4.4 | 2.6 | 2.3 | 4.0 | 150.4 | 2.3 | 21.0 |
| Discards | | | | | | | | | | | |
| US commercial discards | N/A | N/A | N/A | N/A | N/A | 0.5 | 0.1 | 0.3 | N/A | N/A | N/A |
| Catch used in assessment | 4.5 | 5.3 | 6.8 | 6.1 | 4.4 | 3.1 | 2.4 | 4.3 | 150.4 | 4.3 | 21.7 |
| Spawning stock biomass[3] | 18.1 | 20.3 | 18.4 | 13.6 | 10.9 | 14.7 | 25.7 | 32.4 | 180.5 | 10.9 | 48.8 |
| Recruitment (age 1) | 1.1 | 2.6 | 2.3 | 9.6 | 17.0 | 11.9 | 8.7 | 8.3 | 471.9 | 0.4 | [4]8.2 |
| F (ages 4-7) | 0.28 | 0.33 | 0.40 | 0.47 | 0.47 | 0.35 | 0.15 | 0.18 | 0.61 | 0.11 | 0.35 |
| Exploitation rate | 22% | 26% | 30% | 34% | 34% | 27% | 13% | 15% | 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 1996 (Figure C1). Only 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 1963-1996 commercial landings-at-age data tuned with the ADAPT method using Canadian DFO spring and standardized NEFSC spring and autumn survey catch-per-tow-at-age data. The precision and uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1996 were quantitatively evaluated. Discards have been periodically estimated and added to the catch when levels were significant. Estimates of regulatory discarding occurring from 1994-1996 are included in the current assessment.

**Biological Reference Points:** 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 C3). These two reference points are higher than previous estimates because of a decreased exploitation pattern on younger fish.

**Fishing Mortality:** Fishing mortality remained between 0.3 and 0.4 (24-30% exploitation) during most of the 1980s, but increased to about 0.47 (34% exploitation) in 1992 and 1993 before declining to 0.15 (13% exploitation) in 1995 (Figure C1). Accounting for the uncertainty associated with the 1996 F estimates, there is an 80% probability that the 1996 F lies between 0.16 (13% exploitation) and 0.23 (19% exploitation) (Figure C6).

**Recruitment:** The 1988-1990 year classes were poor. The 1992 year class is estimated to be about equal to the 1987 year class which is roughly one third of the average size of the year classes observed during a period of sustained fishery yields of about 50,000 mt per year during 1931-1960. The 1993-1996 year classes are estimated to be smaller than the 1992 year class (Figure C2).

**Spawning Stock Biomass:** SSB declined by 85% between 1978 and 1993 (68,900 mt to 10,900 mt). SSB began to increase in 1994 with improved recruitment, and reached 32,400 mt by 1996 (Figure C2). Accounting for the uncertainty associated with the 1996 SSB estimates, there is an 80% probability that the 1996 SSB was between 27,700 mt and 39,500 mt (Figure C5). The 1996 SSB may be overestimated by as much as 4,000 mt (14%) (see **Special Comments**). 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 4-fold higher than current SSB levels and 50% higher than the management threshold.

**Special Comments:** High survey indices for ages 2-5 in the 1996 US spring survey are a result of a single large tow occurring inside Closed Area 1 which accounted for over 70% of the total survey catch. Terminal year assessment results are sensitive to this tow, and results may be overly optimistic if the survey index is not representative of the population.

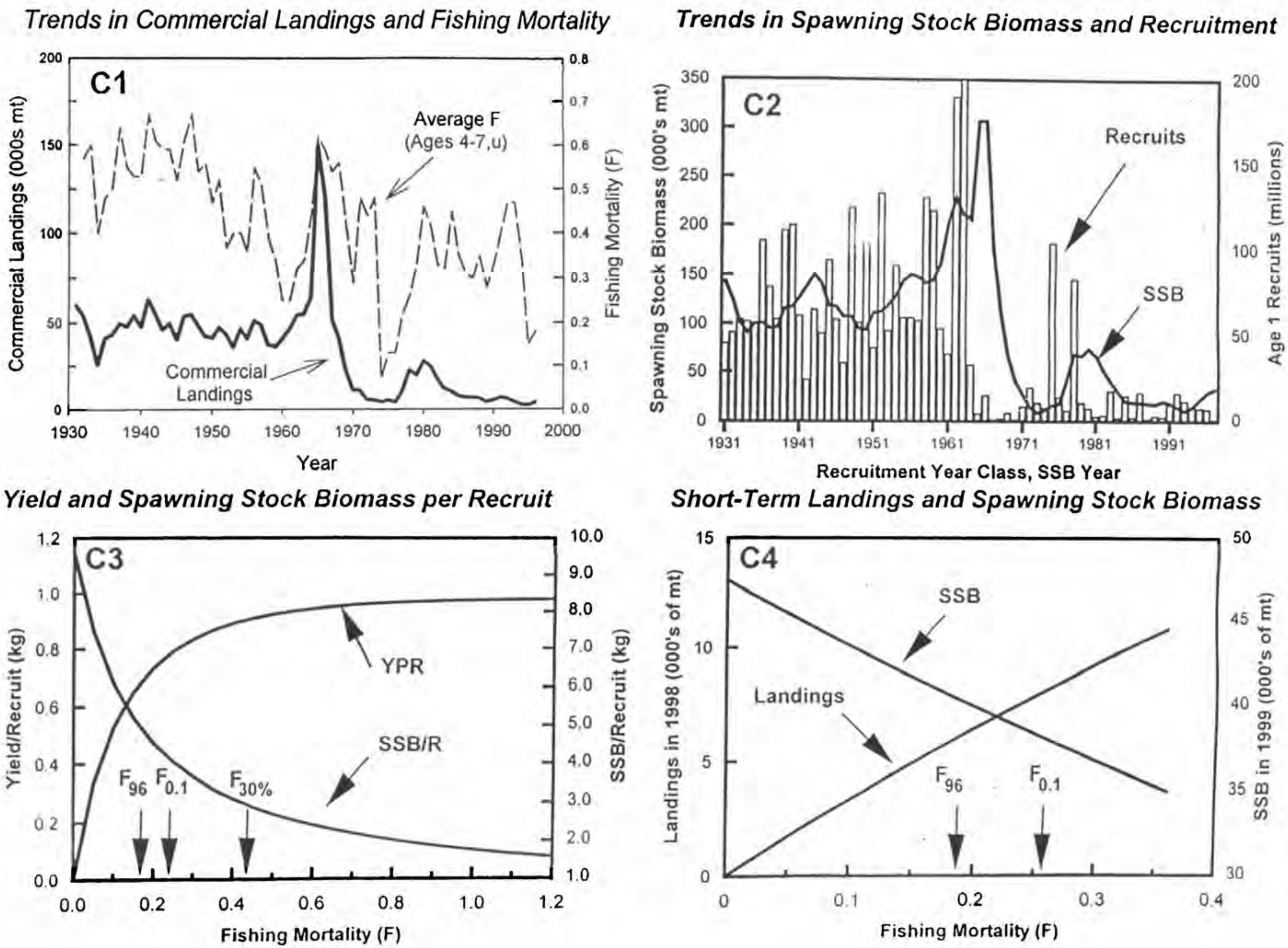
Survey distribution plots, special sampling in and adjacent to Closed Area 1, commercial landings, and discard distributions suggest an increase in haddock abundance in the western portion of Georges Bank. Concentrations of fish appear to be located in the northwest portion of Closed Area 1 and in adjacent areas north and west of the closed area.

Conservative Canadian quotas on haddock and cod and the year-round closure of Area 2 have resulted in reduced fishing mortality in the Northeast Peak area.

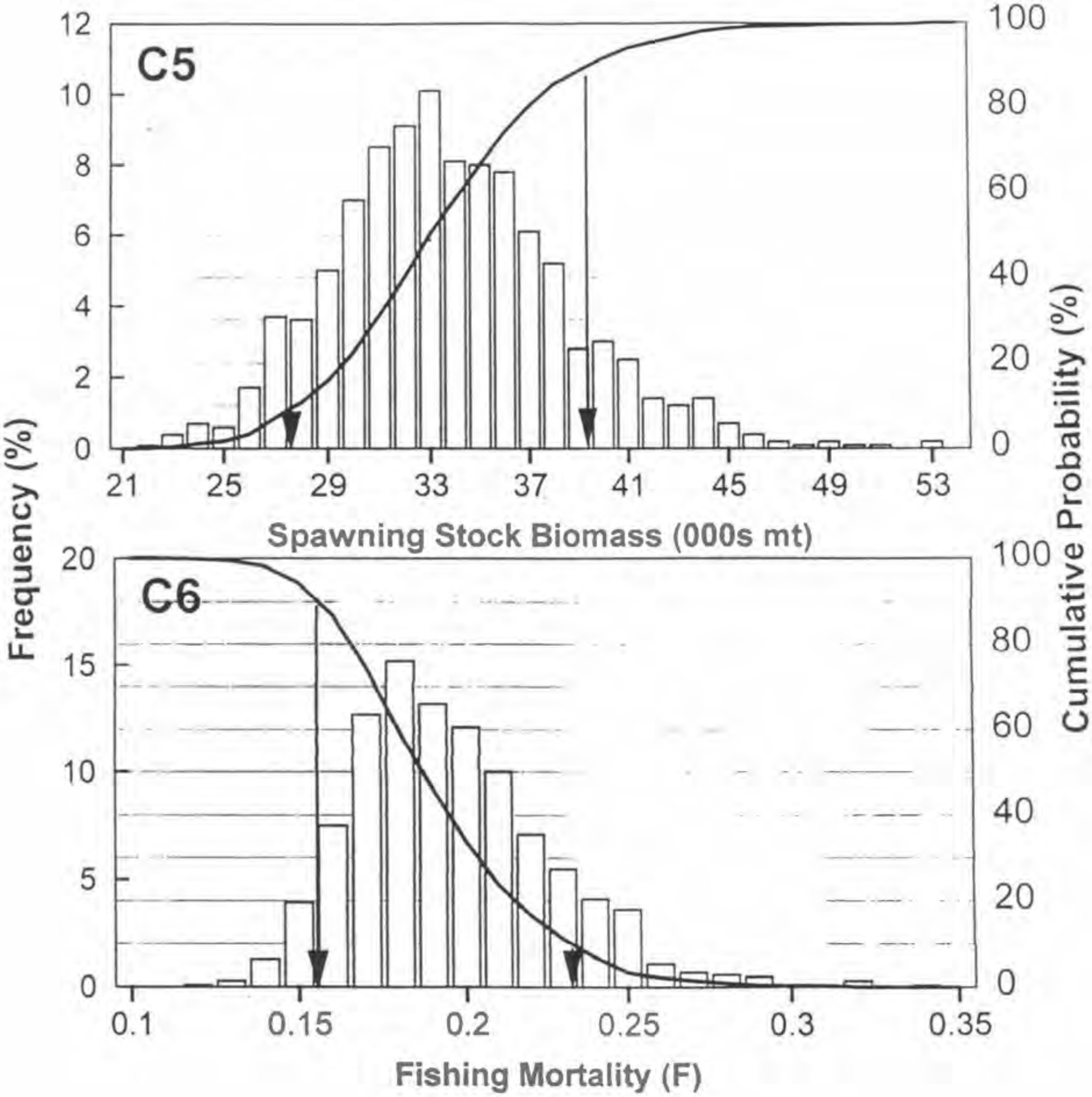
Low levels of sampling of US landings and discard contribute to the uncertainty in estimates of the size and age composition of US catch. In addition, current reporting rates in vessel trip records (logbooks) and at-sea observations by the Sea Sampling program will be inadequate to estimate discards due to trip limits.

**Source of Information:** Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 97-xx; R. Brown, U.S. assessment of the Georges Bank haddock stock, 1997, NEFSC Ref. Doc. 97-xx.

# Georges Bank Haddock



# Georges Bank Haddock



Georges Bank Haddock

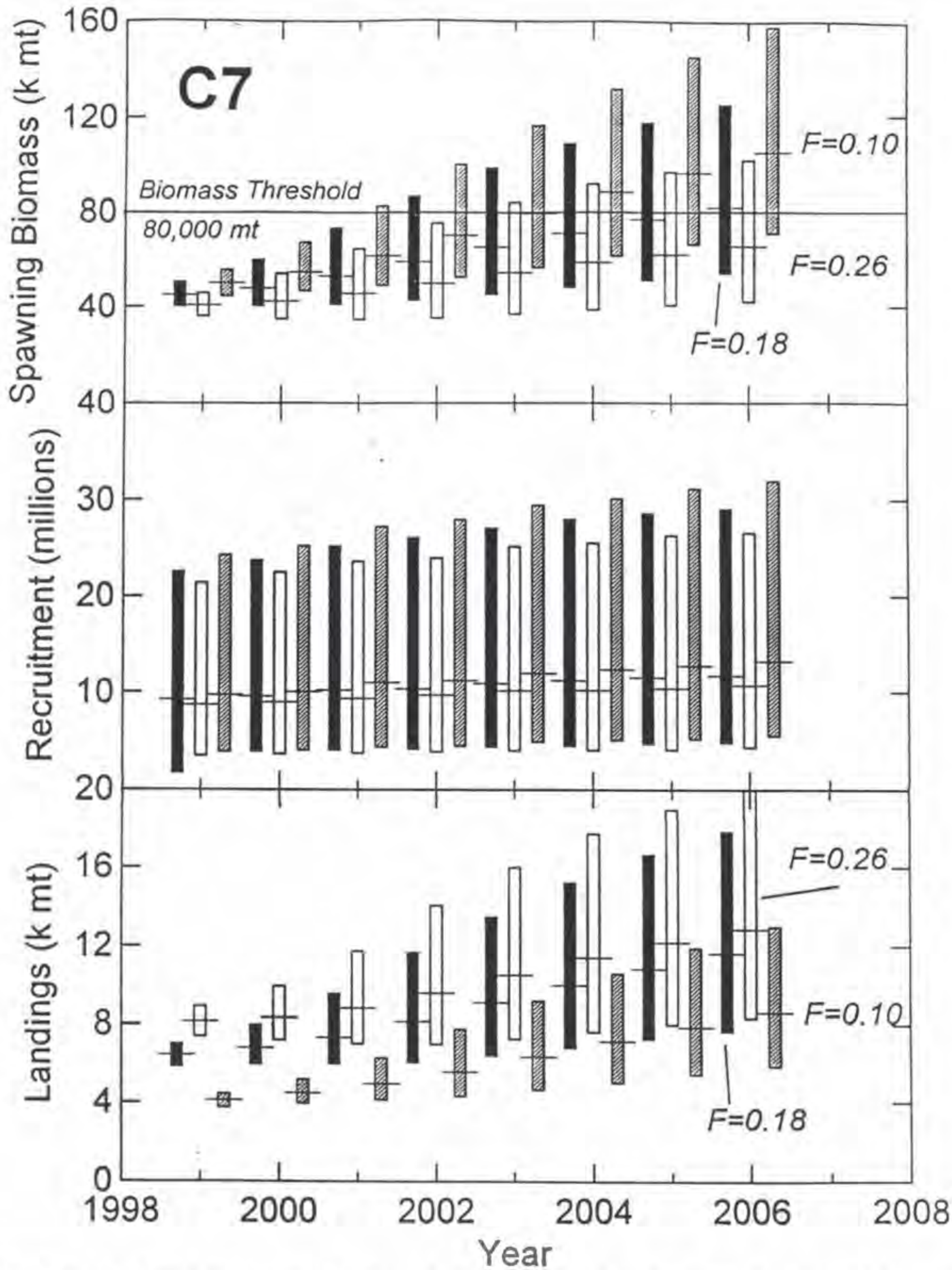



Figure C7. Results of medium-term projections for Georges Bank haddock under three fishing mortality rate scenarios (F = 0.26, 0.18, and 0.10). Annual spawning stock biomass, recruitment, and landings data are given. Horizontal bars are the median values from bootstrap results, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile). Black bars indicate F = 0.18, open bars F = ).26, and shaded bars F = 0.10).

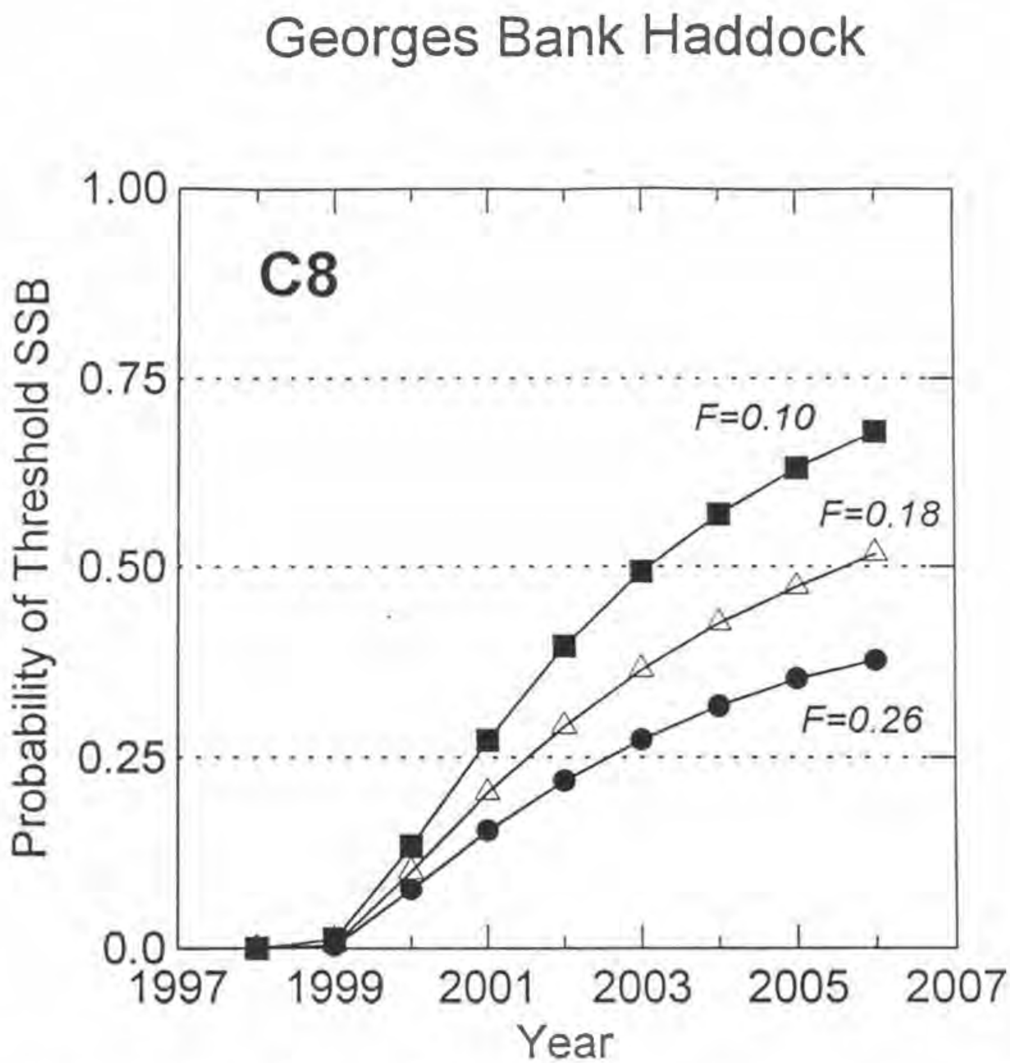



Figure C8. Annual probabilities of Georges Bank haddock spawning biomass at or above 80,000 mt under three fishing mortality rate scenarios. Results are from medium-term stochastic projections.

## D. GEORGES BANK YELLOWTAIL FLOUNDER ADVISORY REPORT

**State of Stock:** Biomass remains low relative to historic levels, but is increasing, with current fishing mortality below the $F_{0.1}$ reference point. Recent increases in spawning stock biomass are due to moderate recruitment and improved survival. Stock biomass (age 1+) in 1996 was 29% of the biomass which would produce maximum sustainable yield (from surplus production modeling) (Figure D2b). Spawning stock biomass in 1996 was 11,700 mt (from virtual population analysis) (Figure D2a). There is a 12% chance that the 1996 SSB was below the rebuilding threshold of 10,000 mt (Figure D6). There is only slight probability that the 1996 fully-recruited fishing mortality from VPA ($F_{96}$ = 0.10 or 9% exploitation rate) exceeded the rebuilding reference point ($F_{0.1}$ = 0.25 or 20% exploitation) (Figure D5). F in 1996 on the total stock biomass from the surplus production model of 0.09 (8% exploitation) is similarly much less than $F_{MSY}$ = 0.31 or 24% exploitation). Age 1 recruitment from 1991 to 1994 was approximately the long-term average, but declined in 1995 and 1996. The 1995 year class is the weakest since 1986.

**Management Advice:** Low levels of fishing mortality (less than $F_{0.1}$) should be maintained to continue stock recovery to the level that produces MSY.

**Forecasts for 1997-1999:** Age-based projections suggest that, at $F_{0.1}$, landings will increase to 2,700 mt in 1997 and SSB will increase to 12,700 mt. Landings and SSB continue to increase in 1998 and 1999 at $F_{96}$ or $F_{0.1}$. Production model projections indicate that, at a target fishing mortality of $F_{96}$, catch will increase to 2,000 mt in 1997.

**Age-based projections:** Basis: VPA estimates of 1997 abundance at age; average 1994-1996 partial recruitment pattern, mean weights at age, and maturation; recruitment estimates drawn from 1973-1995 time series (weights in '000 mt).

| Option | 1997 | | 1998 | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|
| | Landings | SSB | Landings | SSB | SSB | |
| $F_{96}$ = 0.10 | 1.2 | 13.3 | 1.4 | 16.0 | 18.9 | SSB increases in 1999 to about 80% of 1973-1996 average; landings in 1998 increase slightly |
| $F_{0.1}$ = 0.25 | 2.7 | 12.7 | 2.8 | 13.8 | 15.2 | SSB increases in 1999 to 66% of 1973-1996 average; landings in 1998 about twice the 1996 level |

**Biomass-based projections:** Basis: Production model estimates of 1997 biomass, population growth rate as a function of biomass and fishing mortality (weights in '000 mt).

| Option | 1997 |
|---|---|
| | Landings |
| $F_{96}$ = 0.10 | 2.0 |
| $F_{2/3MSY}$ = 0.21 | 4.5 |

**Medium-Term Projections:** Medium-term (10-year) projections were revised for the purpose of comparing the effects of different fishing mortality rate strategies. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1), and landings are given in Figure D7 for fishing mortality rate scenarios of F = 0.10 and 0.25.

Under the $F_{0.1}$ = 0.25 scenario, landings rise steadily from 3,000 mt in 1999 to 8,400 mt in 2006, while spawning stock biomass improves from 17,400 mt to 46,200 mt and recruitment from 31.1 to 47.2 million during 1999-2006. For F = 0.10, landings increase from 1,600 mt in 1999 to 5,500 mt, while spawning stock biomass increases from 21,500 mt in 1999 to 71,600 mt in 2006, and median recruitment improves from 34.5 to 59.8 million fish. For all years of the medium-term simulations, there is a 100% probability that spawning stock biomass exceeds the 10,000 mt threshold.

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

| Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Max | Min | Mean[4] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| US | | | | | | | | | | | |
| Landings | 1.1 | 2.7 | 1.8 | 2.8 | 2.1 | 1.6 | 0.3 | 0.8 | 15.9 | 0.3 | 7.2 |
| Discards | 0.1 | 1.1 | 0.2 | 2.1 | 0.5 | 0.2 | 0.0 | 0.1 | 4.0 | 0.0 | 0.7 |
| Canada | | | | | | | | | | | |
| Landings | <0.1 | <0.1 | <0.1 | <0.1 | 0.8 | 2.1 | 0.5 | 0.5 | 2.1 | 0.0 | 0.1 |
| Discards[1] | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.01 | 0.0 | 0.0 | 0.0 |
| Total catch | 1.2 | 3.8 | 2.0 | 4.9 | 3.4 | 3.9 | 0.8 | 1.3 | 16.4 | 0.8 | 6.7 |
| Biomass[2] | 4.6 | 5.4 | 6.1 | 6.7 | 6.4 | 6.4 | 8.5 | 13.7 | 46.5 | 3.6 | 16.1 |
| SSB[3] | 5.9 | 5.3 | 4.5 | 5.5 | 5.3 | 4.9 | 7.0 | 11.7 | 21.4 | 23.2 | 7.7 |
| Recruitment (age 1)[3] | 8.6 | 12.0 | 22.8 | 19.1 | 23.0 | 22.1 | 16.2 | 7.2 | 68.5 | 5.8 | 22.3 |
| F (age 4+)[3] | 0.84 | 1.00 | 1.35 | 1.17 | 1.04 | 1.68 | 0.30 | 0.10 | 2.19 | 0.10 | 1.12 |
| Exploitation rate[3] | 52% | 58% | 69% | 64% | 60% | 76% | 24% | 9% | 83% | 9% | 62% |
| F (age 1+)[2] | 0.26 | 0.67 | 0.35 | 0.73 | 0.65 | 0.64 | 0.10 | 0.10 | 1.23 | 0.10 | 0.57 |
| Exploitation rate[2] | 21% | 45% | 27% | 48% | 44% | 43% | 9% | 9% | 65% | 9% | 40% |

[1]Canadian discards previous to 1996 are unknown, but considered to be small. [2]From surplus production modeling, 1968-1996. [3]From VPA, 1973-1996. [4]Over period 1968-1996 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. Correlation analysis of the survey indices for Southern New England, Georges Bank, and Cape Cod provide evidence of comparable trends for the first two stocks, but independent trends for the Cape Cod stock.

**Catches:** US landings were generally greater than 10,000 mt from 1963 to 1976, but have not exceeded 3,000 mt since 1984 (Figure D1a). US discards peaked at 4,000 mt in 1976 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 495 mt in 1995 and 483 mt in 1996.

**Data and Assessment:** US landings in 1973-1993 were estimated from dealer records and interview information. US landings in 1994-1996 were prorated from dealer records according to vessel logbook data. US discards at age in 1973-1993 were estimated from vessel interviews, survey length distributions, and sea sampling information. Discards in 1994-1996 were estimated from discard-to-kept ratios reported in vessel logbooks.

Canadian landings of unspecified flounder from Georges Bank have been 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 have decreased to 49 mt in 1996. Canadian industry reports indicate that discards of yellowtail in 1996 were less of a concern than in 1994 or 1995.

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 no age structure is required.

**Biological Reference Points:** Biological reference points did not change from the previous assessment. The previous estimate of $F_{0.1}$ is 0.25 (20% exploitation) (this estimate was incorrectly reported as 0.28 in the last assessment report). F (age 1+) at MSY is 0.31 (24% exploitation).

**Fishing Mortality:** The VPA and the surplus production model produce similar trends in exploitation rates. (Figures D1a and D1b). Fishing mortality was very high ($F > 1.0$) during the 1983-1994 period, but declined in 1995-1996 to the lowest levels observed in the series, less than half of $F_{0.1}$. There is an 80% probability that F in 1996 was between 0.08 and 0.14 (7-12% exploitation) (Figure D5).

**Recruitment:** Age 1 recruitment estimates are available from VPA (Figure D2a). Four dominant year classes of approximately 50 million at age 1 were produced during 1973-1980. All other cohorts in the time series were less than 25 million at age 1. The 1990-1994 cohorts were moderately abundant, but the 1995 year class is the weakest since the 1986 cohort. However, the 1997 Canadian survey indicated above-average numbers of fish at a mode of 25 cm, which are probably age 2. Uncertainty in the estimate of abundance of the 1995 year class does not have a large effect on projected 1997 landings. The current VPA also indicates that the 1992 year class is not as strong as previously estimated.

**Spawning Stock Biomass:** SSB exceeded 21,000 mt in 1973, but declined to less than 4,000 mt during 1984-1988 (Figure D2a). SSB fluctuated below 6,000 mt from 1989 to 1995 and increased to 11,700 mt in 1996. However, historical survey catches of mature yellowtail suggest that historic SSB was approximately 50,000 mt. There is an 80% probability that SSB in 1996 was between 9,800 mt and 14,600 mt (Figure D6). Estimates of biomass from VPA follow similar trends to estimates of total biomass from the surplus production model (Figure D2b). Both models indicate that biomass declined sharply after 1982 to its lowest 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. (Figure D2b).

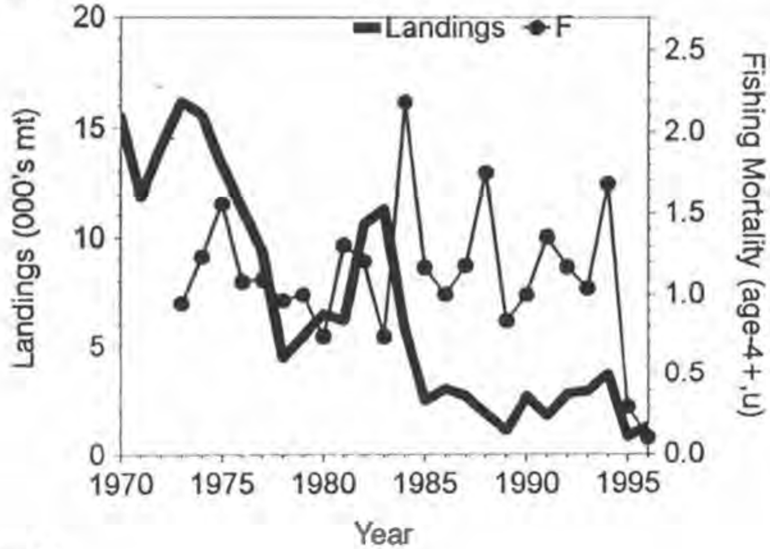
**Special Comments:** The analysis conducted indicate that a 10,000 mt biomass threshold is well below the level which would maximize potential yield.

**Source of Information:** Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 97-xx; S.X. Cadrin, W.J. Overholtz, J.D. Neilsen, S. Gavaris, and S.E. Wigley, Stock assessment of Georges Bank yellowtail flounder for 1997, NEFSC Ref. Doc. 97-xx.

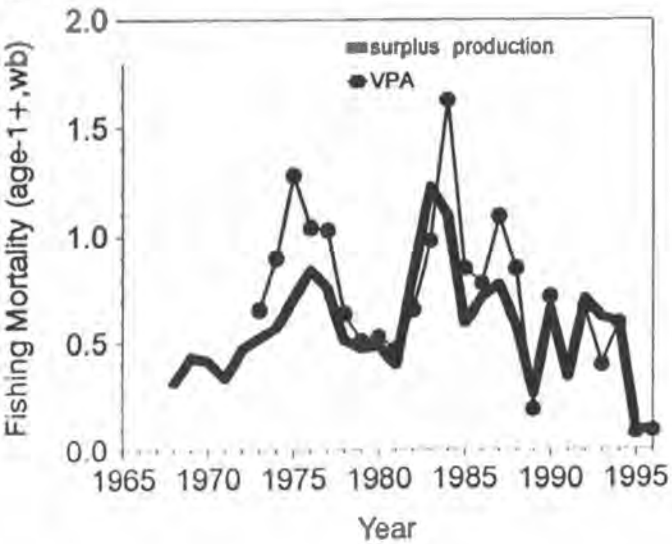
# Georges Bank Yellowtail Flounder

*Trends in Landings and Fishing Mortality*

**D1a**

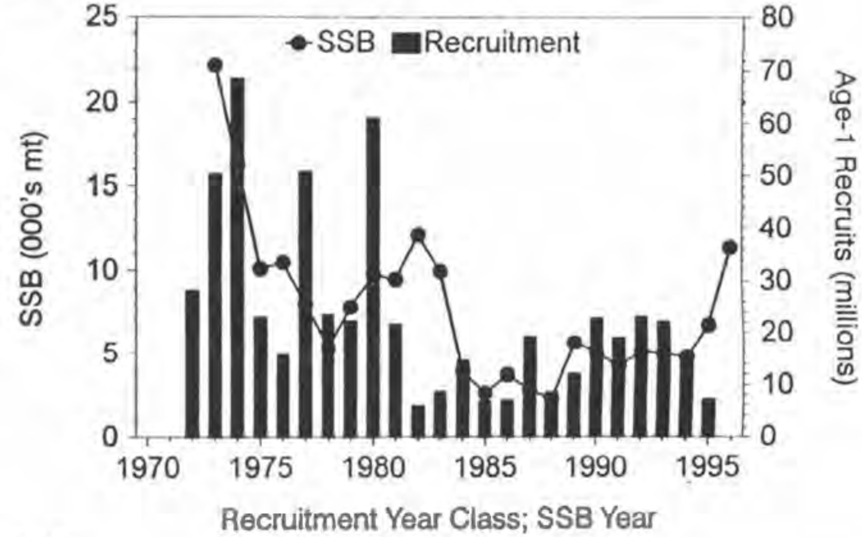



**D1b**

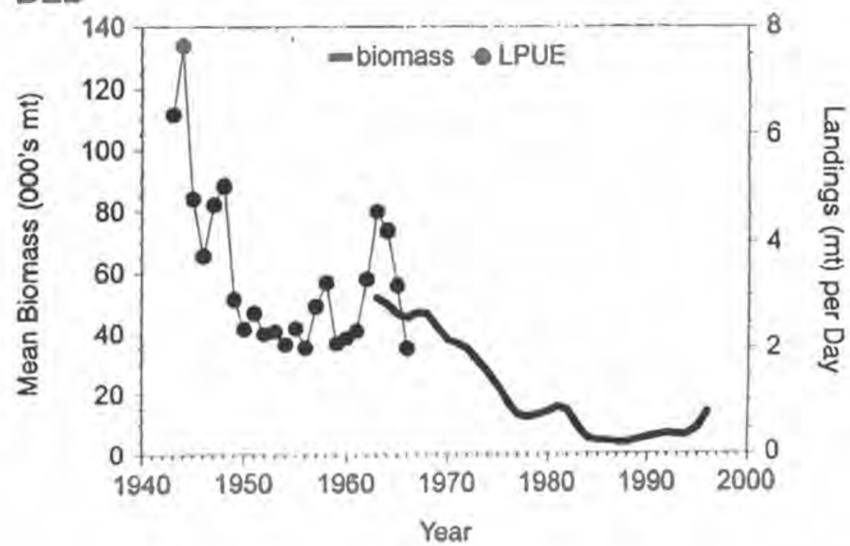



*Trends in Biomass and Recruitment*

**D2a**

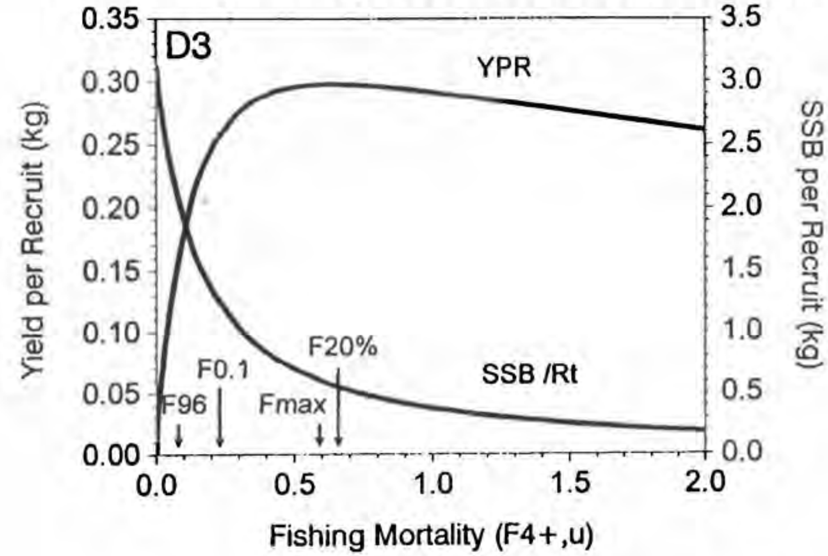



**D2b**

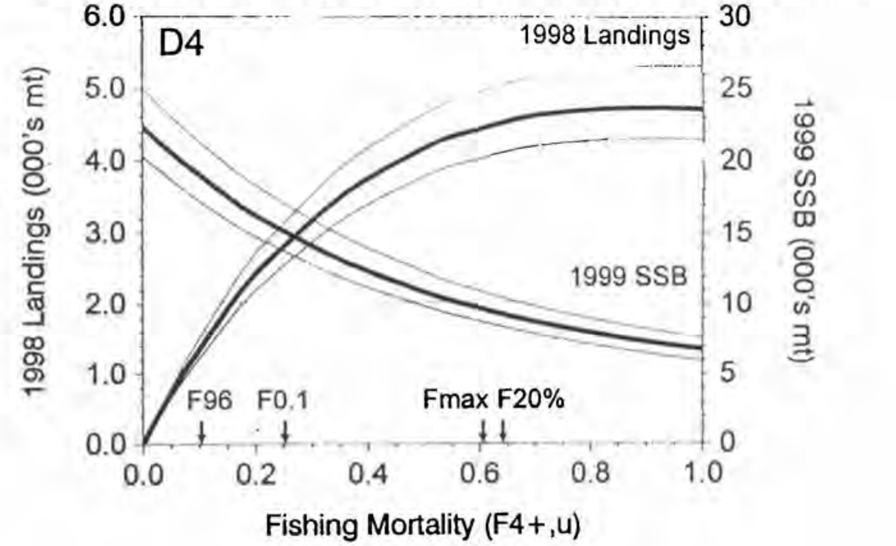


# Georges Bank Yellowtail Flounder

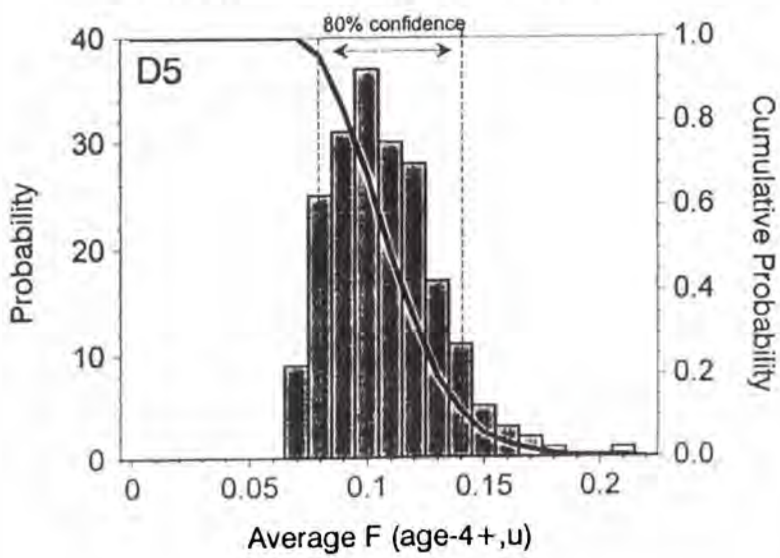
### *Yield and Spawning Stock Biomass per Recruit*



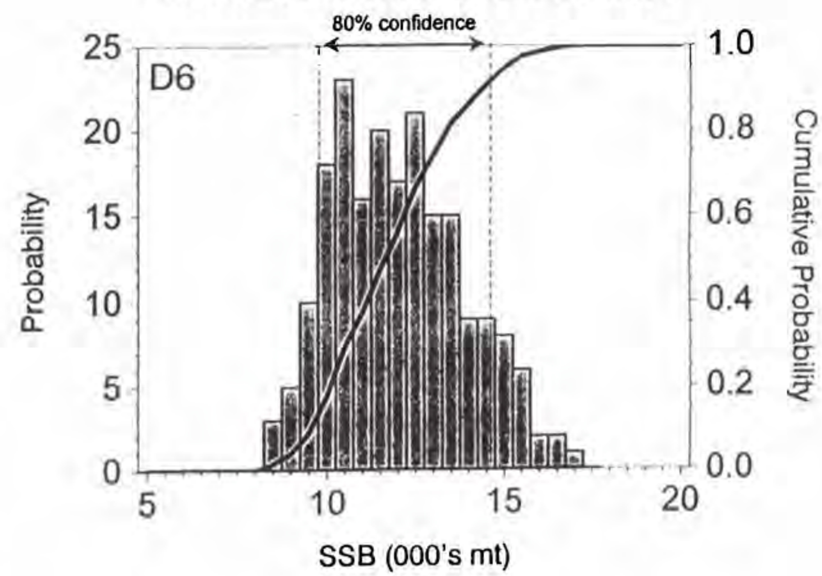

### *Short-Term Landings and Spawning Stock Biomass*




### *Precision of 1996 F Estimate*




### *Precision of 1996 SSB Estimate*



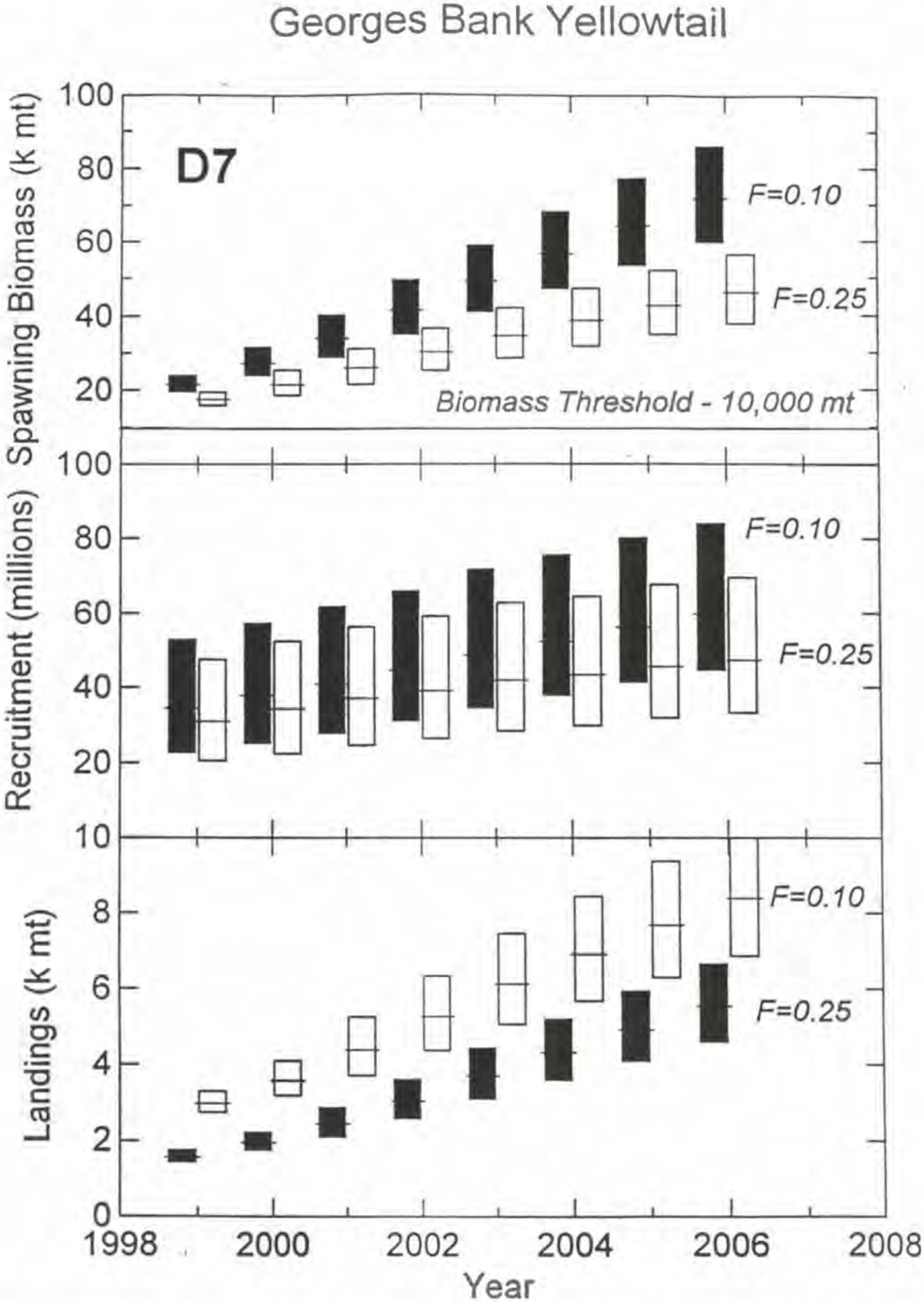



Figure D7. Results of medium-term projections for Georges Bank yellowtail flounder under two fishing mortality rate scenarios (F = 0.25 and 0.10). Annual spawning stock biomass, recruitment, and landings are given. Horizontal bars are the median values from bootstrap results, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile). Black bars indicate F = 0.10 and open bars indicate F = 0.25.

## E. SOUTHERN NEW ENGLAND YELLOWTAIL FLOUNDER ADVISORY REPORT

**State of stock:** Biomass remains low relative to historic levels, but is increasing, with current fishing mortality below the $F_{0.1}$ (0.27) reference point. Recent increases in spawning biomass are due to moderate recruitment and improved survival. Fishing mortality declined from very high levels in the early 1990s to 0.27 (22% exploitation) in 1995 and 0.12 (10% exploitation) in 1996 (Figure E1). There is an 80% chance that fishing mortality in 1996 was between 0.10 (9% exploitation) and 0.20 (16% exploitation) (Figure E5). Spawning stock biomass increased from a low of 1,100 mt in 1993 to 4,300 mt in 1996 (Figure E2), but is still well below the Amendment 7 minimum spawning stock biomass threshold of 10,000 mt. There is an 80% chance that SSB in 1996 was between 2,500 and 5,000 mt (Figure E6).

**Management Advice:** Current low levels of fishing mortality should be maintained to continue stock recovery to the minimum spawning stock biomass threshold level and ultimately to the level that produces MSY.

**Forecast for 1997-1999:** The projection for 1997 at $F_{0.1}$ is for landings of 600 mt; SSB would continue to increase to 5,100 mt. Fishing at $F_{0.1}$ through 1999 would produce higher landings in 1998 (750 mt) and SSB in 1999 would increase to 6,800 mt. Fishing at $F_{96}$ (F = 0.12) would produce landings of 300 mt and an SSB of 5,300 mt in 1997. Projections for SSB in 1998 and 1999 are 6,900 mt and 8,000 mt, respectively, under an $F_{96}$ strategy.

**Forecast Table:** Age-based projections were based on VPA estimates of 1997 stock size at age and assumes average 1994-1996 partial recruitment, mean weight and maturation. Recruitment estimates were drawn from the lower 33% of the 1973-1995 recruitment time series (weights in mt).

| Option | 1997 | | | 1998 | | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|---|---|
| | Landings | Discards | SSB | Landings | Discards | SSB | SSB | |
| $F_{96} = 0.12$ | 300 | 60 | 5,300 | 400 | 80 | 6,900 | 8,000 | SSB increases about 85% from 1996 to 1999; landings slowly increase |
| $F_{0.1} = 0.27$ | 600 | 130 | 5,100 | 750 | 150 | 6,200 | 6,800 | SSB increases about 45% from 1996 to 1999; landings slowly increase |

**Medium-Term Projections:** Medium-term (10-year) projections were revised for the purpose of comparing the effects of different fishing mortality rate strategies. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1), and landings are given in Figure E8 for fishing mortality rate scenarios of F = 0.12 and 0.27. The annual probability that SSB exceeds the 10,000 mt threshold is plotted in Figure E9.

Under the $F_{0.1}$ = 0.27 scenario, landings increase from 1,600 mt in 1999 to 7,200 mt in 2006, while spawning stock biomass improves from 12,000 mt to 40,700 mt and recruitment from 19.3 to 32.3 million fish during 1999-2006. For F = 0.12, landings increase from 900 mt in 1999 to 4,900 mt in 2006, while spawning stock biomass increases from 13,500 mt in 1999 to 57,100 mt in 2006, and median recruitment improves from 19.8 to 37.8 million fish. Under the F = 0.27 scenario, the probability of exceeding the biomass threshold increases from 65% in 1999 to >99% by 2004. For F = 0.12, the annual probability of SSB exceeding the 10,000 mt threshold increases from 76% in 1999 to >99% by 2002 (Figure E9).

## E. SOUTHERN NEW ENGLAND YELLOWTAIL FLOUNDER ADVISORY REPORT

**State of stock:** Biomass remains low relative to historic levels, but is increasing, with current fishing mortality below the $F_{0.1}$ (0.27) reference point. Recent increases in spawning biomass are due to moderate recruitment and improved survival. Fishing mortality declined from very high levels in the early 1990s to 0.27 (22% exploitation) in 1995 and 0.12 (10% exploitation) in 1996 (Figure E1). There is an 80% chance that fishing mortality in 1996 was between 0.10 (9% exploitation) and 0.20 (16% exploitation) (Figure E5). Spawning stock biomass increased from a low of 1,100 mt in 1993 to 4,300 mt in 1996 (Figure E2), but is still well below the Amendment 7 minimum spawning stock biomass threshold of 10,000 mt. There is an 80% chance that SSB in 1996 was between 2,500 and 5,000 mt (Figure E6).

**Management Advice:** Current low levels of fishing mortality should be maintained to continue stock recovery to the minimum spawning stock biomass threshold level and ultimately to the level that produces MSY.

**Forecast for 1997-1999:** The projection for 1997 at $F_{0.1}$ is for landings of 600 mt; SSB would continue to increase to 5,100 mt. Fishing at $F_{0.1}$ through 1999 would produce higher landings in 1998 (750 mt) and SSB in 1999 would increase to 6,800 mt. Fishing at $F_{96}$ (F = 0.12) would produce landings of 300 mt and an SSB of 5,300 mt in 1997. Projections for SSB in 1998 and 1999 are 6,900 mt and 8,000 mt, respectively, under an $F_{96}$ strategy.

**Forecast Table:** Age-based projections were based on VPA estimates of 1997 stock size at age and assumes average 1994-1996 partial recruitment, mean weight and maturation. Recruitment estimates were drawn from the lower 33% of the 1973-1995 recruitment time series (weights in mt).

| Option | 1997 | | | 1998 | | | 1999 | Consequences/Implications |
|---|---|---|---|---|---|---|---|---|
| | Landings | Discards | SSB | Landings | Discards | SSB | SSB | |
| $F_{96} = 0.12$ | 300 | 60 | 5,300 | 400 | 80 | 6,900 | 8,000 | SSB increases about 85% from 1996 to 1999; landings slowly increase |
| $F_{0.1} = 0.27$ | 600 | 130 | 5,100 | 750 | 150 | 6,200 | 6,800 | SSB increases about 45% from 1996 to 1999; landings slowly increase |

**Medium-Term Projections:** Medium-term (10-year) projections were revised for the purpose of comparing the effects of different fishing mortality rate strategies. The starting conditions for these projections were slightly different than for the above short-term projections, and the latter remain the most appropriate for point estimates of catch in 1997-1998 and spawning stock biomass through 1999. The median, lower 25th, and upper 75th percentiles of projected spawning stock biomass, recruitment (age 1), and landings are given in Figure E8 for fishing mortality rate scenarios of F = 0.12 and 0.27. The annual probability that SSB exceeds the 10,000 mt threshold is plotted in Figure E9.

Under the $F_{0.1} = 0.27$ scenario, landings increase from 1,600 mt in 1999 to 7,200 mt in 2006, while spawning stock biomass improves from 12,000 mt to 40,700 mt and recruitment from 19.3 to 32.3 million fish during 1999-2006. For F = 0.12, landings increase from 900 mt in 1999 to 4,900 mt in 2006, while spawning stock biomass increases from 13,500 mt in 1999 to 57,100 mt in 2006, and median recruitment improves from 19.8 to 37.8 million fish. Under the F = 0.27 scenario, the probability of exceeding the biomass threshold increases from 65% in 1999 to >99% by 2004. For F = 0.12, the annual probability of SSB exceeding the 10,000 mt threshold increases from 76% in 1999 to >99% by 2002 (Figure E9).

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

| Year | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | Max | Min | Mean[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Landings | 2.5 | 8.0 | 3.9 | 1.4 | 0.5 | 0.2 | 0.2 | 0.3 | 17.0 | 0.2 | 4.2 |
| Discards | 5.1 | 9.1 | 2.5 | 1.1 | <1 | <1 | <1 | <1 | 9.1 | <1 | 2.6 |
| Catch | 7.6 | 17.1 | 6.4 | 2.5 | 0.5 | 0.2 | 0.2 | 0.3 | 20.8 | 0.2 | 6.7 |
| SSB | 21.9 | 14.3 | 4.0 | 1.7 | 1.1 | 1.1 | 2.7 | 4.3 | 21.9 | 1.1 | 7.7 |
| Recruitment (age 1) | 16.5 | 6.9 | 3.8 | 2.5 | 2.8 | 9.9 | 5.2 | 12.0 | 126.9 | 2.5 | 29.1 |
| F (age 4+) | 1.33 | 2.51 | 2.10 | 1.71 | 0.82 | 0.82 | 0.27 | 0.12 | 2.51 | 0.12 | 1.20 |
| Exploitation rate | 68% | 86% | 82% | 76% | 51% | 51% | 22% | 10% | 86% | 10% | 65% |

[1]Over period 1973-1996.

**Stock Distribution and Identification:** 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 parasite infestations. Some intermixing occurs with stocks on Georges Bank and off Cape Cod.

**Catches:** Landings for this stock peaked in 1969 at 33,200 mt, but declined to 1,600 mt in 1976 (Figure E1). 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 years, respectively. Landings declined to 1,400 mt in 1992 and have since dropped to record low levels.

**Data and Assessment:** Southern New England yellowtail flounder was last assessed at SAW-17 in 1994. 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 for 1994-1996 were prorated from dealer records and vessel logbooks. Discards during 1973-1992 were estimated from vesssel interviews, sea sampling trips, and survey length compositions. Discards for 1993-1996 were estimated from discard ratios obtained from vessel logbooks.

**Biological Reference Points:** Biological reference points were recalculated because of changes in selectivity during 1994-1996. $F_{0.1}$ = 0.27 (22% exploitation) for this stock (Figure E3).

**Fishing Mortality:** Fishing mortality on this stock was very high during 1982-1994 with exploitation rates ranging from 65% to 86%. Fishing mortality dropped to F = 0.27 (22% exploitation) in 1995 and F = 0.12 (10% exploitation) in 1996 (Figure E1).

**Recruitment:** The strongest year classes in the 1973-1996 series were the 1980 and 1987 cohorts at 127 million and 122 million age 1 fish, respectively (Figure E2). Year classes from 1989-1995 have all been relatively small, ranging from 2.5 million to 12.0 million fish. The 1993 cohort is currently supporting the recovery of this stock. The 1995 year class may be about equal in size to the 1993 cohort, but additional estimates in 1998 and 1999 will be required to better estimate the size of this cohort.

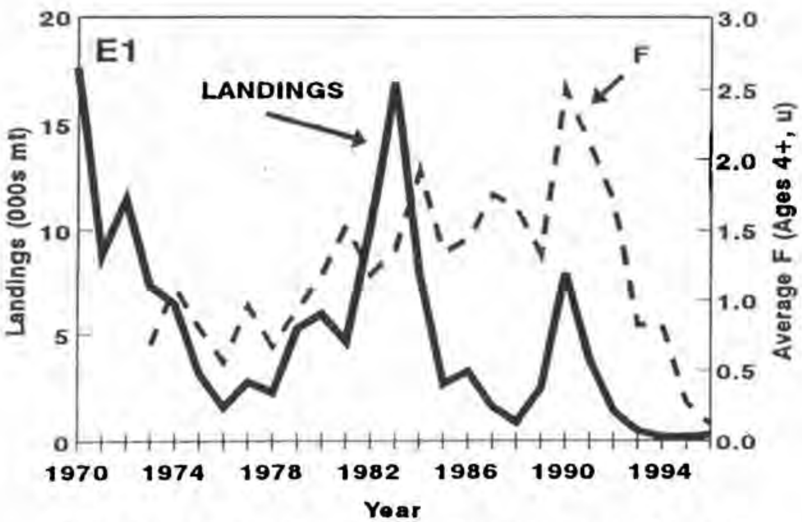
**Spawning Stock Biomass:** Spawning stock biomass peaked at 22,000 mt in 1989 with the recruitment of the strong 1987 year class. The spawning stock declined steadily thereafter to 1,100 mt in 1993 (Figure E2). SSB began to slowly recover in 1995 reaching 2,700 mt and increased further to 4,300 mt in 1996. Projections for 1997-1999 suggest that spawning stock biomass will continue to slowly increase as long as fishing mortality remains low. SSB during 1973-1996 exceeded 20,000 mt only in 1982 and 1989; however, autumn survey indices prior to 1973 suggest that SSB at that time was probably on the order of 2-3 times this level (Figure E7).

**Special Comments:** Discarding in the otter trawl segment of this fishery has declined due to increases in mesh size and area closures. A new source of discarding began in 1994 in the sea scallop fishery due to regulations that prevented the landing of groundfish in excess of 500 lb. If the yellowtail stocks on Georges Bank, Southern New England, and elsewhere recover, discards from this fishery could become significant in the future. As the stock recovers, directed fishing and discarding may increase and the current management measures may be insufficient to maintain low levels of fishing mortality.

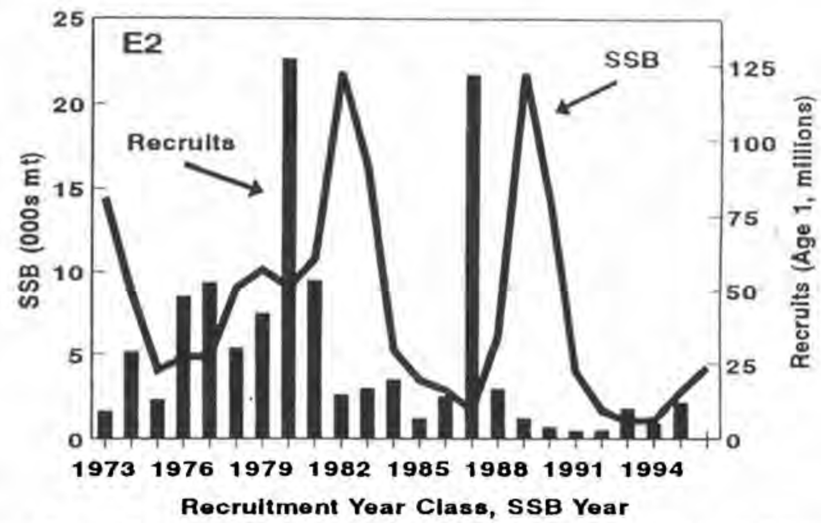
**Source of Information:** Report of the 24th Northeast Regional Stock Assessment Workshop (24th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 97-xx; W.J. Overholtz, S.X. Cadrin, and S Wigley. Assessment of the Southern New England Yellowtail Flounder Stock for 1997, NEFSC Ref. Doc. 97-xx.

# Southern New England Yellowtail

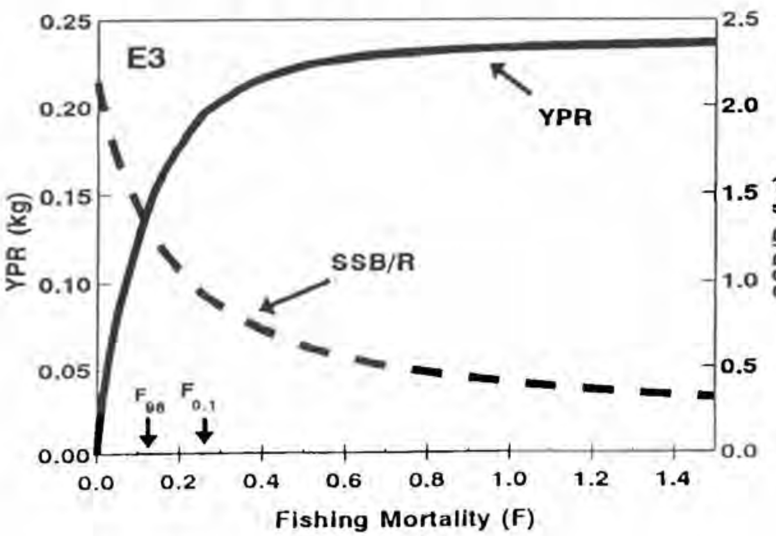
***Trends in Commercial Landings and Fishing Mortality***



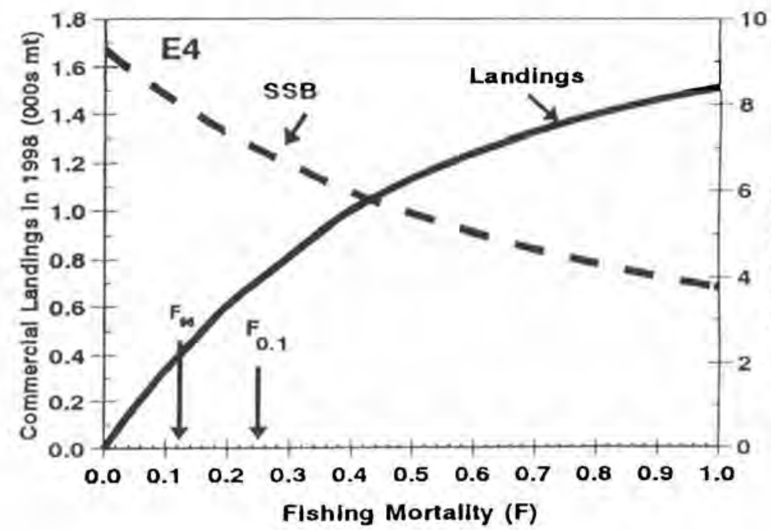

***Trends in Spawning Stock Biomass and Recruitment***




***Yield and Spawning Stock Biomass per Recruit***

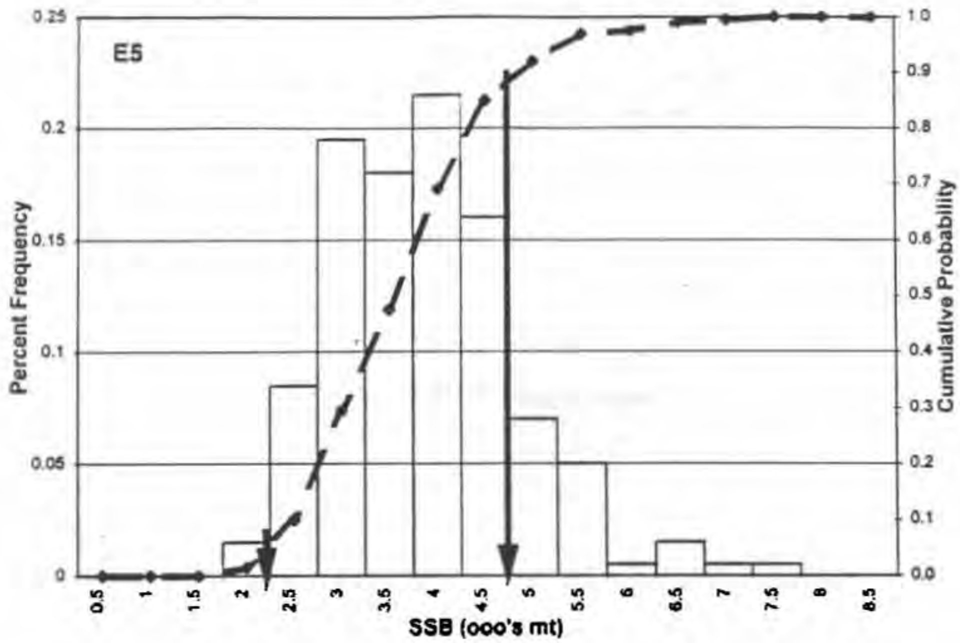


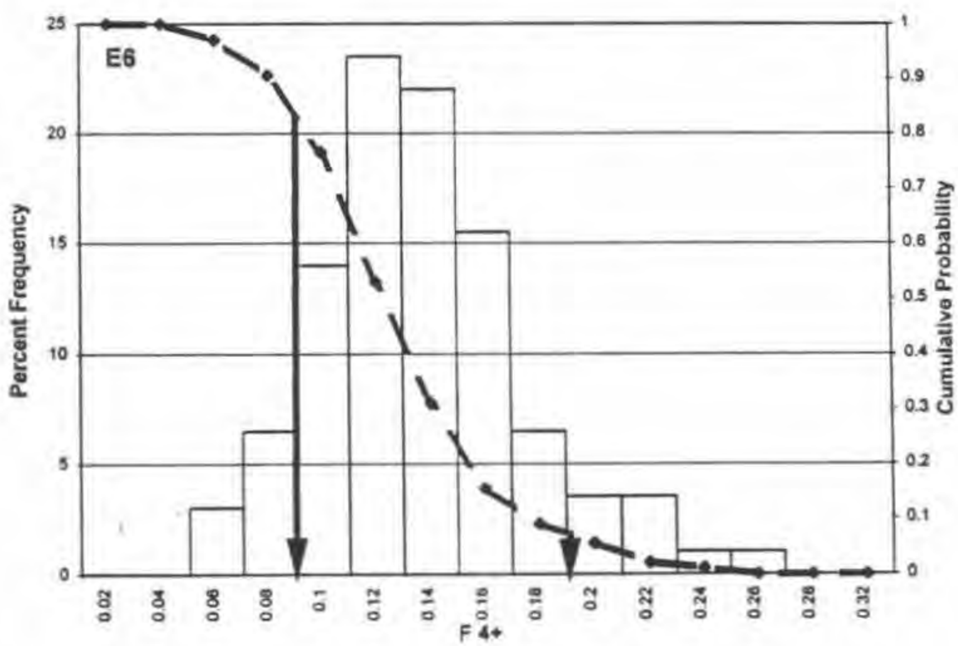

***Short-Term Commercial Landings and Spawning Stock Biomass***



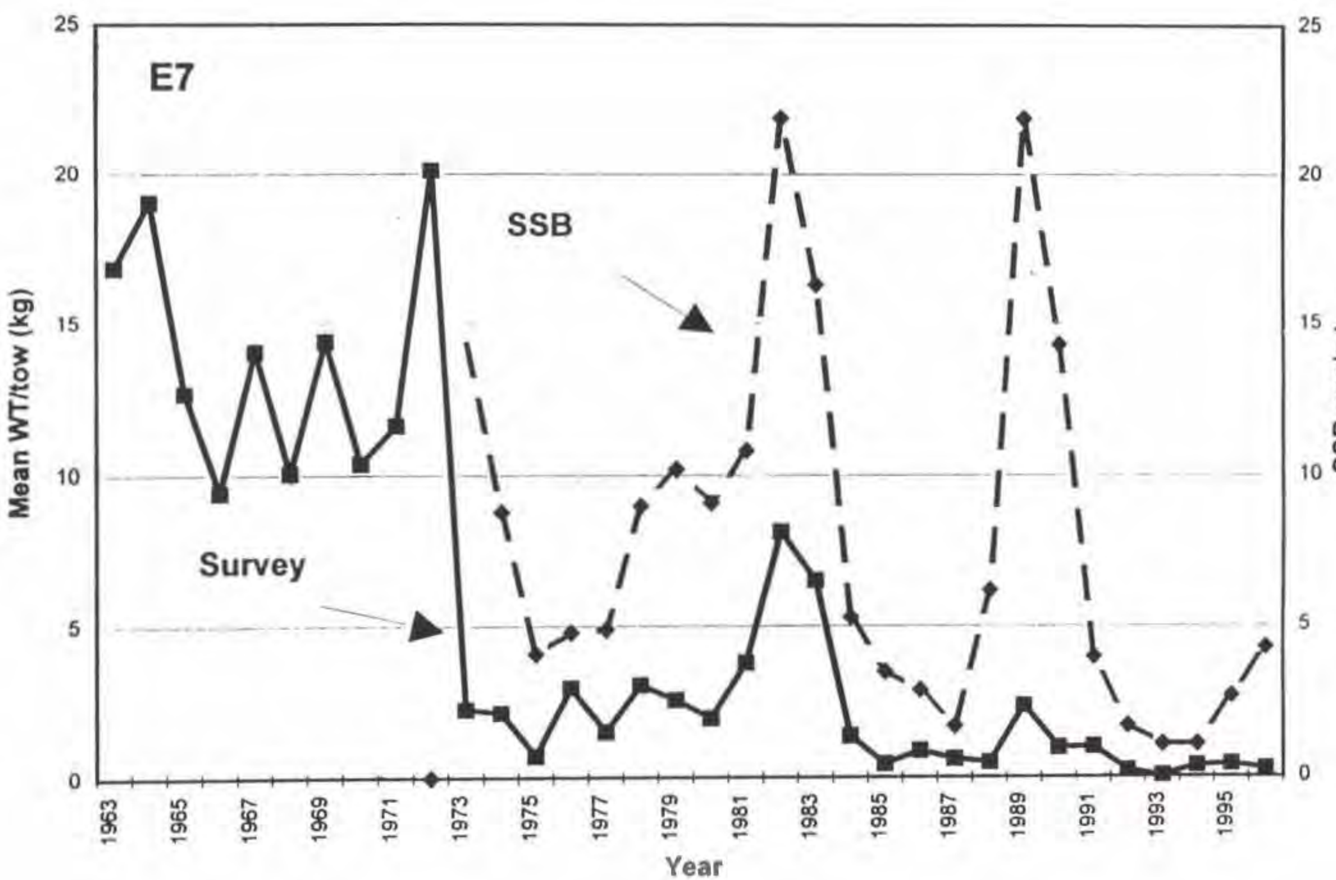
## Southern New England Yellowtail

*Precision of Estimates for SSB and F*



## Southern New England Yellowtail



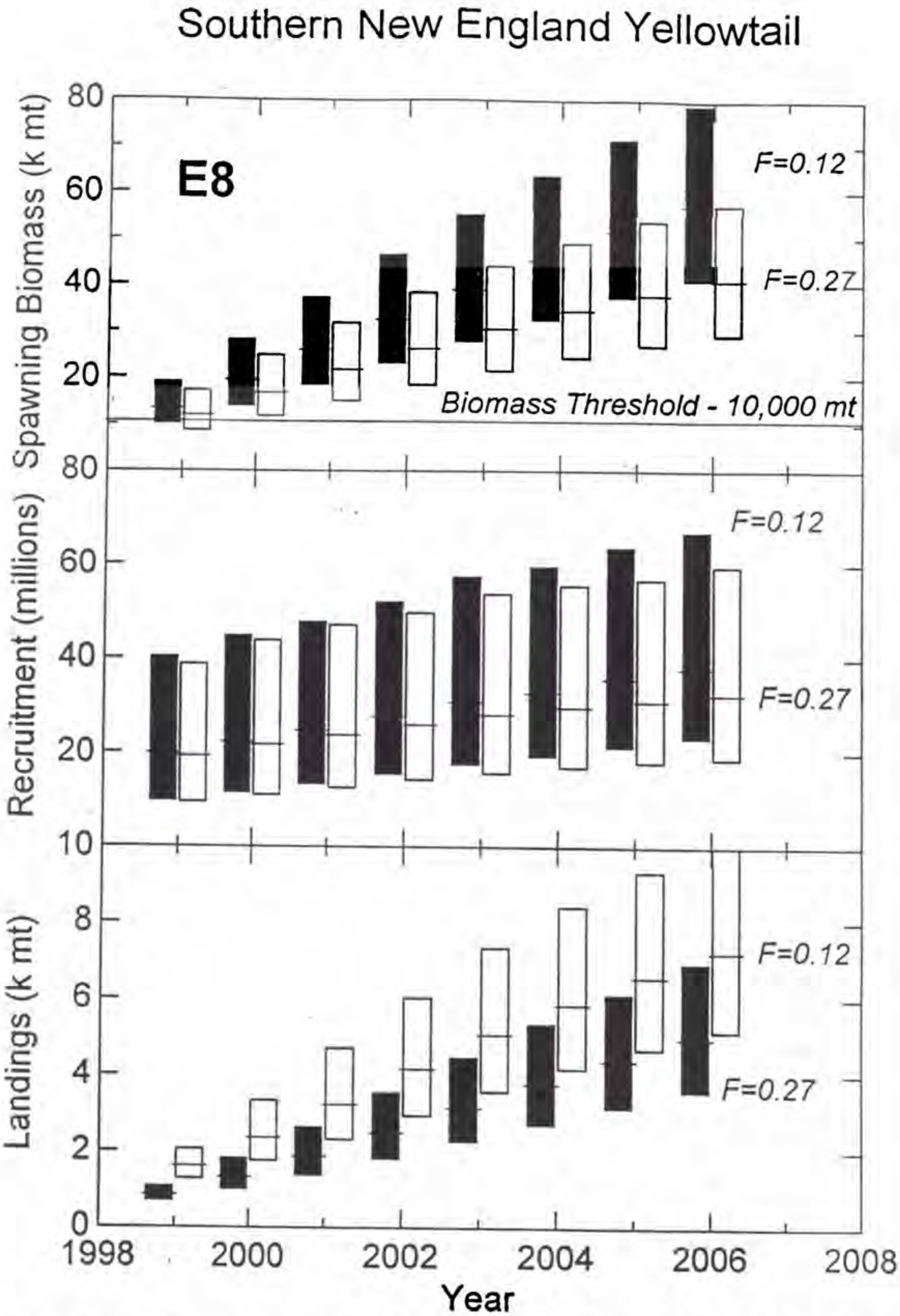



Figure E8. Results of medium-term projections for Southern New England yellowtail flounder under two fishing mortality rate scenarios (F = 0.12 and 0.27). Annual spawning stock biomass, recruitment, and landings data are given. Horizontal bars are the median values from bootstrap results, vertical bars are the inter-quartile range (lower 25th percentile to the upper 75th percentile). Black bars indicate F = 0.12 and open bars indicate F = 0.27.

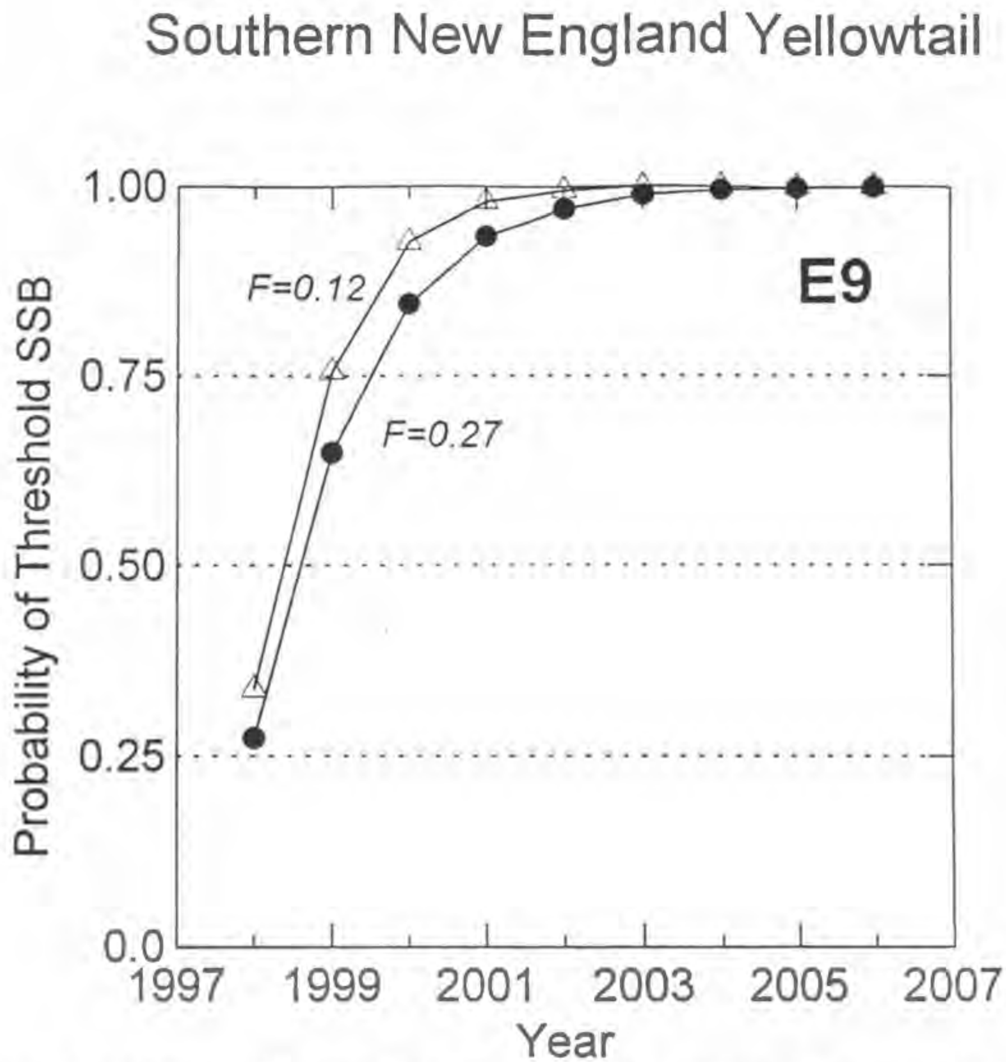


Figure E9. Annual probabilities of Southern New England yellowtail flounder spawning biomass at or above 10,000 mt under two fishing mortality rate scenarios. Results are from medium-term stochastic projections.

# CONCLUSIONS OF THE SAW STEERING COMMITTEE

## CONCLUSIONS OF THE SAW STEERING COMMITTEE

The SAW Steering Committee met once during the SAW-24 cycle by teleconference on April 18, 1997. The discussion at and conclusions from that meeting are summarized below.

### Teleconference of April 18, 1997

The SAW Steering Committee met by teleconference on April 18, 1997. Participants were: J. Dunnigan, ASMFC; D. Keifer, MAFMC; P. Howard, C. Kellogg, A. Applegate, NEFMC; A. Rosenberg, NMFS/NER; M. Sissenwine, F. Serchuk, E. Anderson (SAW Chairman), H. Mustafa (SAW Coordinator), NMFS/NEFSC.

Although the main reason for the meeting was to discuss the SAW issue paper on modifying the SAW process in light of increased demands for advice and the need to broaden participation in the assessment and peer-review aspects of the process, the agenda also included a discussion of species and meeting dates for SAW-25 and SAW-26.

Issue Paper

Dr. Anderson reviewed the background for the development of an issue paper (**Appendix I**) which he had drafted on the basis of discussion at the December 16, 1996 Steering Committee meeting. The draft distributed to Committee members already reflected Dr. Sissenwine's comments. Members offered various comments for improving the draft.

Based on a discussion of differences between responsibilities of Council plan development teams (PDTs) or monitoring committees (MCs) and the SAW, it was concluded that a clear distinction should be specified.

There was considerable discussion on a possible Atlantic coast SAW process in which concerns were expressed that 1) the number of additional stocks to be handled would exceed the number of additional scientists involved, 2) the process in the Northeast would be slowed, 3) the workloads of PDT and NEFSC staff would increase and decrease their availability for other tasks, and 4) would jeopardize the timely provision of assessment results and management advice to the two Councils in the Northeast Region. It was felt that an integrated coast-wide process might eventually be feasible, but parallel processes in the Southeast and Northeast Regions should initially be pursued.

Dr. Anderson reported that he, Dr. J. Powers (NMFS/SEFSC), and Dr. V. Restrepo (NMFS/S&T) had been tasked by the NMFS Atlantic Coastal Board with preparing a draft proposal on an Atlantic stock assessment review process. The draft proposal would be completed by May 1 for consideration by the Board and would also be circulated to Committee members for their review and comment. Feedback was anticipated from relevant people in the Southeast Region within several months.

The need for a funded pool of external experts (national and international) to participate in both Working Group and SARC meetings, and possibly help reduce the NEFSC workload, was emphasized.

Dr. Anderson noted that he had participated in an April 9, 1997 meeting at ASMFC Headquarters in Washington, DC of the ISFMP Stock Assessment Review Process Subcommittee which had met to further discuss and redraft a document being prepared for the ASMFC Management and Science Committee. The revised document, which made frequent reference to the SAW process and outlined circumstances under which assessments of stocks under the responsibility of ASMFC would be handled within the SAW process, was later adopted by ASMFC.

Surfclam Research

Dr. Anderson reported that quota could not be offered to industry vessels as compensation for their participation in a forthcoming calibration study of the dredge used for the surfclam/ ocean quahog surveys conducted by the R/V *Delaware II*. Instead, vessels would be asked, via a Federal Register notice of solicitation of interest, to voluntarily provide assistance in a planned depletion experiment. This approach had been deemed acceptable by the MAFMC Surfclam and Ocean Quahog Committee.

## SAW-25

The first three of the four following stocks, their terms of reference, and the date and place for the SARC meeting, agreed earlier by the Steering Committee (teleconference of February 13, 1997), were confirmed. In addition, at the request of ASMFC, northern shrimp was added to the SAW-25 agenda, with approval of terms of reference left to the SAW Chairman. It was agreed that the SARC would only peer review the assessment, particularly new analytical methodology, and not provide specific management advice for the next fishing season. This would remain the responsibility of the ASMFC Northern Shrimp Technical Committee and would be accomplished following analysis by the Committee of the results from its annual August shrimp survey in the Gulf of Maine. Dates for the Public Review Workshop sessions were agreed.

*Stocks*

Summer flounder
Scup
Black sea bass
Northern shrimp

*Terms of reference*

Summer flounder:

a. assess the status of summer flounder through 1996 and characterize the variability of estimates of stock abundance and fishing mortality rates;

b. provide projected estimates of catch for 1997-1998 and SSB for 1998-1999 at various levels of F, including $F_{target}$;

c. provide medium- to long-term stock size and catch projections under various constant fishing mortality or constant catch scenarios with the aim of achieving stock rebuilding at an MSY level.

Scup:

a. assess the status of scup through 1996 and characterize the variability of estimates of stock abundance and fishing mortality rates;

b. to the extent feasible, provide projected estimates of catch for 1997-1998 and SSB for 1998-1999 and characterize the variability of estimates of stock abundance and fishing mortality rates.

Black sea bass:

a. assess the status of black sea bass through 1996 and characterize the variability of estimates of stock abundance and fishing mortality rates;

b. to the extent feasible, provide projected estimates of catch for 1997-1998 and SSB for 1998-1999 and characterize the variability of estimates of stock abundance and fishing mortality rates.

Northern shrimp:

a. evaluate trends in stock abundance and fishing mortality rates for Gulf of Maine northern shrimp and characterize the variability of estimates;

b. assess stock status relative to biological reference points based on yield per recruit (e.g., $F_{0.1}$, $F_{max}$) and percent maximum spawning potential (e.g., $F_{20\%}$);

c. advise on long-term management strategies and overfishing definitions.

*Meeting dates and places*

SARC
July 21-25, 1997
Woods Hole, MA

Public Review Workshop
MAFMC
August 14, 1997
Philadelphia, PA
NEFMC
October 2, 1997
Wakefield, MA

SAW-26

The possibility of delaying consideration of Atlantic herring until SAW-26 (spring 1998) was suggested. The biggest problem with herring was the lack of data on which to base assessments of individual spawning stocks. Current management demands were for advice on individual components of the coastal stock complex. Until further research was conducted on stock structure and methods (e.g., acoustic surveys) developed to assess individual stocks, innovative approaches would be required.

Silver hake and Georges Bank winter flounder were both mentioned for possible consideration, but a number of issues remain to be resolved yet before a new assessment can be done for the former. Advice on the latter will be needed soon by the NEFMC.

The following stocks, and the SARC meeting dates, were tentatively agreed.

*Tentative stocks*

Surfclam
Ocean quahog
Weakfish
Atlantic herring

*Meeting dates and places*

SARC
December 1-5, 1997
Woods Hole, MA

Public Review Workshop
January 1998

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

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

| YEAR | 85 | 1986 | | 1987 | | 1988 | | 1989 | | 1990 | | 1991 | | 1992 | | 1993 | | 1994 | | 1995 | | 1996 | | 1997 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 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 |
| Black Sea Bass | 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 | | |
| Cod, Gulf of Maine | X | | X | | | | X | | | | | X | | | X | | | | X | | + | | | X | | |
| Cusk | X | | | | | | | | | | | | | | | | | | | | + | | | | | |
| Flounder, Am. Plaice | 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 | | | | | |
| Flounder, Winter, GOM | | | | | | | | | | | | | | | | | | | | | X | | | | | |
| Flounder, Winter, GB | X | | X | | | | | | | | | | X | | | | | | | | | | | | | X |
| Flounder, Witch | X | X | | | | | | | | | | | | | | | | X | | | + | | | | | |
| Flounder, Yellowtail, SNE | X | X | | | | | X | | | | | X | | | | | X | | | | + | | | X | | |
| Flounder, Yellowtail, GB | X | X | | | | | X | | | | | X | | | | | | X | | | + | | | X | | |
| Goosefish | | | | | | | | | | | | | | X | | | | | | | + | | X | | | |
| Haddock, Georges Bank | X | X | | X | | | | | | | | | X | | | | | | | X | + | | | X | | |
| Haddock, Gulf of Maine | X | X | | | | | | | | | | | | | | | | | | | + | | | | | |
| Herring, Atlantic | | | | | 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 | | | | | | |
| 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 | | | |
| Scup | 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 | | | | | | | | |
| Squid, Illex | X | X | | X | | X | | X | | X | | X | | X | | | X | | | | X | | | | | |
| Squid, Loligo | X | X | | X | | X | | X | | X | | X | | X | | | X | | | | X | | | | | |
| Striped Bass | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| Surfclam | X | | X | | | | X | | X | | | | | | X | | | | X | | | X | | | | |
| Tautog | | | | | | | | | | | | | | | | | | | | X | | | | | | |
| Tilefish | X | | | | | | | | | | | | | X | | X | | | | | | | | | | |
| Weakfish | | | + | | | | | | | | | | | | | | | | | | | | | | | |
| White Hake | 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

## NORTHEAST REGIONAL STOCK ASSESSMENT WORKSHOP (SAW)

# ISSUE PAPER

## Modifying the SAW Peer-Review Process to Meet Changing Expectations

by

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NOAA/NMFS
Northeast Fisheries Science Center
Woods Hole, MA

### Introduction

The purpose of this issue paper is to present ideas and possible ways for improving the current Northeast Regional Stock Assessment Workshop (SAW) process to enable it to better accommodate an already heavy, but steadily increasing, demand for assessment advice and to enhance the credibility of the advice through an expanded participation by scientific experts in the peer-review process.

Modifications to the SAW need to be considered in light of how the process has evolved since it began in 1985. The history of the SAW process is reviewed to give a better perspective for proposed changes.

The views expressed in this paper are a reflection of several SAW Steering Committee discussions in December 1996 and February 1997. The Committee consists of the Executive Directors of the Mid-Atlantic and New England Fishery Management Councils (MAFMC and NEFMC), the Executive Director of the Atlantic States Marine Fisheries Commission (ASMFC), the Regional Administrator of the NMFS Northeast Region, and the Science and Research Director of the NMFS Northeast Fisheries Science Center.

### History of SAW Process

The inaugural meeting of the Northeast Regional Stock Assessment Workshop (SAW) process, held July 8-12, 1985, was sponsored by the Conservation and Utilization Division of the NMFS Northeast Fisheries Center (NEFC) and attended by representatives of seven State marine fisheries agencies, the Mid-Atlantic and New England Fishery Management Councils, the NMFS Northeast Regional Office, and the NEFC. The agenda included a review of the 33 species/stocks then being monitored by the NEFC.

Goals of SAW-1 were to 1) identify data requirements for assessment and the adequacy of current assessments, given present and projected management needs, 2) specify approaches to enhance cooperation among States and the Federal government in upgrading assessments of mutual interest and in the expeditious delivery of these assessments to appropriate management bodies, 3) prioritize future assessment activities based on projected management concerns, and 4) assign lead assessment responsibilities for all species based on State versus Federal expertise and/or jurisdiction.

The change to a workshop format in the Northeast Region for conducting and peer reviewing assessments stemmed from a need for 1) greater peer review of the scientific and technical aspects of assessments, 2) involving scientists external to the NEFC who had different perspectives and access to data not typically used by the NEFC, 3) encouraging the development of assessment expertise in State and academic institutions, and 4) reviewing biological and management terms of reference for stock assessment studies to make more efficient use of limited research resources.

One of the outcomes of SAW-1 was the decision to hold semiannual (spring and autumn) NEFC stock assessment workshops to present and review assessments of selected stocks of primarily Federal interest based on Council schedules/needs and data availability. It was also the consensus that assessments of stocks occurring mainly in State waters be handled in a series of concurrent assessment working groups which would meet prior to ASMFC annual meetings. The report on the status of stocks produced from each semiannual NEFC workshop would replace the individual species assessment documents previously generated by NEFC staff.

A number of working groups were established at SAW-2 (May 5-9, 1986) to address analytical or research problems. The concept of specifying both scientific and management terms of reference for subsequent workshops was implemented.

Assessment information was classified at SAW-3 (September 8-12, 1989) as ranging from complete revisions to updates of previous assessments. The SAW report contained not only summaries of selected stock assessments, but reports of research working groups and summaries of discussions on other topics. Source documents containing further information were listed in the SAW report for each species reviewed. The number of assessments reviewed was 12, compared to 33 at SAW-1.

At SAW-4 (March 30-April 3, 1987), concern was raised as to the optimal number of workshop participants as well as their scientific qualifications. A distinction was made between assessment experts (defined as "participants") and others who, because of specific knowledge and interests, might be of assistance to workshops for special information (defined as "observers"). Because SAW reports were considered the primary source of stock assessment information for the Northeast Region and, therefore, should constitute the "best available scientific information", they should include an accurate summary of both the assessment information and relevant workshop discussion.

At SAW-8 (April 24-27, 1989), it was recognized that recent workshops had evolved from the original concept of stock assessment review sessions to include an increasing number of ancillary research topics, leaving insufficient time for in-depth discussions of any single issue. Several modifications to the workshop format were proposed to alleviate this problem:

1) alternate workshops between research topics and stock assessments;

2) working groups meet separately from the SAW to conduct assessments during week-long intensive, hands-on sessions, with the SAW held later to review the reports; SAW becomes review body apart from working groups;

3) assessments conducted during week-long SAW sessions with all participants actively engaged in the analyses;

4) SAW remains in present format, but review of working papers done by *ad hoc* working groups which provide summary for plenary review;

5) current 3-day format be increased to full week.

A SAW Documentation Working Group was established at SAW-9 (November 27 - December 1, 1989) to evaluate current and future possibilities for documentation of information disseminated at and prepared by the SAW. The number of assessments reviewed had averaged about six for SAWs 4-9. It was decided that subsequent SAWs should be structured to allow working sessions on topics or assessments during the first two days of the meeting, with the results from these sessions presented later in plenary. Canadian DO scientists participated for the first time since Canadian assessments of three transboundary stocks were on the agenda.

At SAW-10 (June 4-8, 1990), a recurring theme throughout the meeting was the need to change the SAW structure and outputs to better address management needs. A report from the SAW Documentation Working Group led to a recommendation for a basic restructuring that included:

1) a Steering Committee of senior administrators (Regional Office, NEFC, NEFMC, MAFMC, and ASMFC Directors) to set priorities, allocate resources, and oversee the assessment review and advisory process;

2) assessment working groups and individuals to prepare and present assessment results in working papers;

3) a Stock Assessment Review Committee of assessment experts to provide critical peer review of assessments and produce a consensus summary of stock status and assessment results;

4) a Plenary Session for Scientific Advice, including most of the SAW participants, which would review assessment summaries and (non-assess-

ment) working group reports and use them to produce an advisory document to contribute to SAFE (Stock Assessment and Fishery Evaluation) reporting requirements.

SAW-11 was held in two sessions: 1) the Stock Assessment Review Committee (SARC) (October 15-19, 1990) and 2) the Plenary (November 5-7, 1990). The Plenary agreed on a standardized format for assessment reports to facilitate their presentation and review. The SAW-11 report consisted of three sections: 1) The Plenary, 2) Stock Assessment Review Committee Consensus Summary of Assessments, and 3) Advisory Report on Stock Status. The latter provided a summary of the technical information contained in the SARC report and scientific advice for fishery managers on stock status.

The SAW Steering Committee was activated in November 1990 and held its first meeting December 20, 1990.

Attendance at the first ten SAWs ranged between 55 and 86 people from a broad spectrum of agencies, organizations, and institutions in the Northeast, all of whom were viewed as participants in the official peer-review process. SAW-11, however, was the first meeting of the SARC, comprised of 11 assessment experts, nine of whom were from within the Northeast Region (NEFC, the two Councils, and one State) and two from outside the Region.

At the SAW-14 Plenary (July 15-16, 1992), there was considerable discussion on addressing procedural and logistical problems associated with the SARC process: 1) insufficient lead time for assessments, 2) duration of the SARC meeting, 3) use of assessment working groups, and 4) review of work done outside the SARC/SAW process. A SAW Procedures Study Group was established to develop new protocols for improving SARC/SAW procedures.

The SAW Steering Committee, at an August 17, 1992 meeting, reviewed and generally concurred with a report on "A Proposal for Restructuring the Northeast Regional Stock Assessment Workshops".

At SAW-15, the draft Advisory Report on Stock Status, for the first time, was prepared at the SARC meeting (December 7-11, 1992) for presentation and finalization at the Plenary (January 26-27, 1993). The Advisory Report had previously been prepared totally at the Plenary. SAW-15 also marked the departure from a single report, containing sections on the Plenary, SARC Consensus Summary of Assessments, and Advisory Report on Stock Status, to two reports. The first report contained the SARC Consensus Summary of Assessments. The second report contained a Summary of the Plenary, the Advisory Report, reports on Special Topics, and, also for the first time, Conclusions of the SAW Steering Committee.

The SAW Steering Committee, at a March 25, 1993 meeting, reviewed its functions and agreed on a revised SAW structure which has largely remained intact up to the present time.

1) Steering Committee functions:

    a) attend the SAW Plenary and discuss management advice;

    b) set priorities for review of the 48 stocks in the Region, allocate resources (people and funding), and oversee the assessment and advisory process;

    c) select species/stocks to review at the next SARC;

    d) set terms of reference for assessments;

    e) set dates and places for SARC and SAW Plenary meetings;

    f) evaluate sufficiency and style of SARC and Advisory reports and additional communication required;

    g) set Subcommittees in force and functioning.

2) Five standing assessment Subcommittees (Northern Demersal, Southern Demersal, Pelagic/Coastal, Invertebrate, and Assessment Methods) to be chaired by NEFSC personnel, have assigned species (except latter Subcommittee), and meet in advance of SARC meeting to conduct assess-

ments and prepare working papers for SARC review;

3) Stock Assessment Review Committee (two open meetings each year):

   a) Function: to oversee the assessment process, review the information prepared by Subcommittees and provide peer review of the assessments, develop research needs for next assessment, and determine the advice to managers;

   b) Composition (at least 12 members): Chairman, four *ad hoc* assessment experts chosen by the Chairman from the Northeast Fisheries Science Center (NEFSC), State personnel from Maine-North Carolina, one person from each Regional Fishery Management Council, one person from ASMFC, one person from NMFS Northeast Regional Office, and one scientist each from Canada, academia, and outside the Region (typically from another NMFS Fisheries Science Center).

4) SAW Plenary will be a 1-day forum held in conjunction with Council or ASMFC meetings for presenting and discussing scientific advice.

5) SAW documentation will include SARC Subcommittee working papers, SARC Consensus Summary of Assessments, Advisory Report on Stock Status, and SAW Plenary Report.

The SAW Steering Committee, at most of its meetings until about mid-1994, discussed the SAW process and either considered or authorized particular procedural changes aimed at improving the process. A recurring problem raised at most of those meetings was the difficulty in obtaining SARC and Subcommittee members from State agencies and academia.

In addition to all the other changes that have occurred in the SAW process, the Plenary itself has changed in content and length. Whereas it was initially a 2-day meeting devoted to discussing assessment results, framing advice, and receiving reports on other topics, it was reduced, starting with SAW-16, to a 1-day session (July 29, 1993) which included only the presentation and discussion of advice. By decision of the Steering Committee on February 17, 1995, the single Plenary was replaced, beginning with SAW-20, by a Public Review Workshop with two sessions, one in conjunction with a MAFMC meeting (August 2, 1995) and the other in conjunction with a NEFMC meeting (August 10, 1995). In addition, the time for the presentation of advice at each session was shortened from a full day to a half day. This procedure has continued to the present time (i.e., SAW-23), with the time for Public Review Workshop presentations decreasing even further to 2-3 hrs at each session.

**Problems and Potential Solutions**

Discussions by the SAW Steering Committee on July 29, 1996 and by the SARC on November 20, 1996 (SAW-23) produced a list of problems associated with the current SAW process together with an even longer list of potential solutions.[2] These lists, as follows, provided the basis for a major Steering Committee discussion on December 16, 1996:

Problems

- Growing demand for more assessment advice
- Overlap in SARC, Council Monitoring Committee, and ASMFC Technical Committee responsibilities
- ASMFC peer-review needs
- Demands for more "independence of peer review"
- Inadequate data
- Insufficient assessment expertise and participation at State level
- Insufficient NEFSC expertise on Council Monitoring Committees and ASMFC Technical Committees
- Inadequate access to Federal data bases by experts outside NEFSC
- Problematic or poorly-understood analytical models and complicated reports
- Inadequate linkage between advice and implementation
- National concerns
- Assessment of US-Canada transboundary stocks

Potential Solutions

- Expand/extend present two 1-week SARC meetings per year
- Provide multi-year advice (e.g., surfclams, ocean quahogs, summer flounder, and others)
- Distinguish routine updates from "benchmark" assessments
- Broaden meeting participation
    - Industry participation/representation on Subcommittees and SARC
    - Academic/scientific consultant participation on Subcommittees and SARC
    - Expertise from abroad
    - Financial support for academics/consultants
    - Federal/ASMFC financial support to States earmarked for hiring assessment experts
    - Greater State/Council/academic access to Federal data bases
    - Shorter and more understandable technical reports
    - Rotation of venues for Subcommittee meetings
    - Greater involvement of field biologists, relevant graduate students, economists, oceanographers, etc.
- Bring all ASMFC peer reviews into the SAW process
- Divide responsibilities among SARC, Council Monitoring Committees, and ASMFC Technical Committees
- Delegate more responsibility to Subcommittees (first drafts of advice, concise summaries)
- Speed up SARC meetings
    - Shorter terms of reference for species
    - Allocate less time for discussion per stock
    - Implement policy of accepting/rejecting, but not redoing assessments
- Peer review by correspondence (e.g., journal process)
- Greater NEFSC participation on Council Monitoring Committees and ASMFC Technical Committees if such groups assume assessment responsibilities
- Address concerns/problems with assessment methodology
    - "Primers" or "cookbooks" of assessment methods
    - Reconstitute Assessment Methods Subcommittee and name new Chairman
- Greater adherence to policy of distributing Subcommittee documents 2 weeks in advance of SARC meetings
- Coast-wide SAW process

Additional Steering Committee Comments

Although the SAW process has always been dynamic with subtle changes occurring as necessary, significant changes are now mandated to cope with heavy demands for scientific advice which are expected to increase further.

Care must be taken not to make the SARC all things to all people (e.g., inclusion of economic and methods issues). Although issues such as economics and methods (essential to assessments) must be addressed somewhere, the SARC is not necessarily the appropriate forum.

There are perceptions of credibility, communication, and problems associated with the availability of data, or lack thereof. Credibility is generally associated with the advice provided and how the advice meets the needs of the group dependent on it. The credibility of data is also an issue. Although the data problem can probably never be fully resolved to everyone's satisfaction, the summer flounder analysis is a good example of how to address inadequate data. Also, as proven in the case of bluefish, when information transfer/communication improves, so does the perception of scientific credibility.

## Requirements for the SAW Process

The fundamental reason for attempting to restructure the SAW process is to be able to provide more assessment advice in a timely fashion while also ensuring that it will be of the highest quality practicable and thus be credible in spite of increasing external scrutiny. The following requirements form the basis for a modified SAW process:

1) transparency (ability to attend and participate in meetings) and openness (ability to contribute scientific information to as well as participate in meetings);

2) Subcommittee/Working Group and SARC consensus of outcome (more independent/external participants, no individual dominance);

3) timeliness of output (timetable matching management specifications, quick dissemination of information);.

4) increased quantity of output (many more stocks than presently, perhaps 20 or more per year);

5) reduce external criticism (build in fail-safe procedures to accommodate demands for independence, without separate review processes that are expensive, e.g., NRC reviews).

**Types of Peer-Review Processes**

Three types of possible peer reviews for a modified SAW were identified by the Steering Committee:

1) Integrated review: Integrate peer review into assessment process itself (i.e., a Working Group, with the participation of more external experts, would review its own assessment).

2) Sequential review: Similar to the current process where analysis and peer review are done in sequence by Subcommittees and the SARC, with an overlap between the two tiers and the SARC assuming "ownership" (including responsibility for flaws) of accepted assessments. The peer-review body would meet more than twice a year. Although advice from Working Groups may be reframed under this format, assessments would not be reworked, but would, if necessary, be referred back to the Working Group for consideration at a later meeting. The peer review would focus on promoting consistency.

3) Independent review: A review panel of members who have had no involvement with the assessment(s) being reviewed and are not associated with the management process or the affected industry such that there would be a perception of a conflict of interest. This type of peer review would be especially important where high stakes were concerned and would have to be used sparingly. This approach would be recommended for use in case of a major change in, problem with, or question on the status of a stock or in management, for "benchmark" assessments, or a major change in assessment methodology. There would be no overlap between the analysis and peer-review functions, the review forum would not redo unacceptable assessments nor assume "ownership" of accepted assessments.

**Preferred Process**

A two-tier, sequential process, with increased participation by State and independent experts, is the format preferred by the Steering Committee for dealing with most reviews:

1) Working Groups, consisting of either a) current SARC Subcommittees or b) Working Groups in other organizations (e.g., ASMFC) augmented by NEFSC and independent experts, would prepare assessments and provide initial reviews based on terms of reference established by the Steering Committee.

2) The Stock Assessment Review Committee (SARC) would peer review assessments to promote consistency and adopt/reframe advice developed by Working Groups. The SARC would meet three times a year to review assessments, would not redo unacceptable analyses, and would refer unacceptable work back to Working Groups for revision.

An independent review capability should be built into the process to accommodate the need for an NRC-type review. This capability should be used on an as-needed basis and involve experts with no specific research connection or "vested interest" in the species under review. Such a review could report to the SARC or directly to the Steering Committee, depending on the circumstances.

The Steering Committee would set priorities on species to be assessed, specify terms of reference, establish the need to review again (independent review) or re-assess, and schedule special Working Group and other meetings as necessary.

The new process must involve more people and probably more, but shorter, SARC meetings, but potentially these meetings could be shorter in duration than at present. A simplified reporting process under an expanded workload, such as summarizing meeting results once a year instead of for each meeting, could be considered.

Current SARC Subcommittees should be renamed "Working Groups" so as to be more consistent with practices in other organizations (e.g., ICES) and countries, to denote a more flexible structure, and also to reflect the increased importance of the independence of membership.

Although there may be standardization and consistency problems, a whole array of Working Groups could function under the SAW umbrella, including independent expert groups, existing ASMFC groups (but with a more diversified membership through the infusion of NEFSC personnel and independent participants), and other groups tasked with developing management advice. Plan Development Teams (PDTs) and Monitoring Committees (MCs) would still address particular management specifications for Council needs.

There should be more flexibility regarding the establishment of Working Groups. The current SARC standing Subcommittees, each responsible for particular groups of species, could be replaced by a variety of short- and long-term Working Groups created by the Steering Committee, as needed, to perform assessments for particular species or groups of species for the next SAW or handle other tasks of a longer-term nature. These might include multispecies groups, some long-term groups, some very specific short-term (e.g., species-specific) groups, and some independent/standing groups.

### Types of Assessments

The Steering Committee considers the various assessments that are performed and reviewed within the SAW process to be included in one of the following three categories:

1) <u>benchmark</u> assessment: update all input data, new analytical methods likely or re-examination of previous assessment assumptions and analytical methods (e.g., all the groundfish stocks for SAW-24);

2) <u>updated</u> assessment: update catch-at-age data and survey indices for latest year(s), run new VPA, make new catch/stock projections (e.g., summer flounder and scup for SAW-25);

3) <u>exploratory</u> assessment: characterized as first-time or possibly repeat assessment where data are highly uncertain and output equally uncertain, assemble or update available data (e.g., catch at age, survey), attempt analytical methods and catch/stock projections, (e.g., black sea bass for SAW-25).

### Unification of Regional Reporting of Stock Status

NEFSC staff have traditionally been responsible for conducting assessments of the fish stocks in Federal (Northeast Region) waters of the Northwest Atlantic. Prior to 1977, these assessments were done in conjunction with or reviewed by scientists from the various countries involved in fishing in the Northwest Atlantic. This was done within the Standing Committee on Research and Statistics (STACRES) of the International Commission for the Northwest Atlantic Fisheries (ICNAF). The results from these and the other assessments of stocks in the ICNAF area (about 70 in total) were published annually in the *ICNAF Redbook*.

Following the US withdrawal from ICNAF at the end of 1976 coincident with implementation of the Magnuson Fishery Conservation and Management Act (MFCMA), the assessments for stocks in US waters of the Northwest Atlantic were performed exclusively by NEFSC staff. Beginning in 1977, summaries of these assessments were published annually by the NEFSC in a "Status of the Stocks" report containing standardized 2-page summaries of the important species/stocks in the Northeast Region. The first report in 1977 included summaries for 25 species/stocks, whereas the most recent report (for 1994) contained synopses for 39 species/stocks.

The inaugural meeting of the SAW process in 1985 included a review of the 33 species/stocks then being assessed or monitored by the NEFSC and summarized in the annual "Status of the Stocks" reports. Even though subsequent SAW reports have included summaries of the stock assessments reviewed at the respective SARC meetings (ranging between 3 and 15 per meeting), the NEFSC has continued to publish annual (except for 1995) reports on the *Status of the Fishery Resources off the Northeastern United States*.

Even though the format, content, and general purpose of the SAW reports and the NEFSC "Status of the Stocks" reports have differed somewhat, it is now time to give serious consideration to their incorporation. This would eliminate unnecessary duplication of effort and redundancy of reporting and encapsulate all assessment results and management advice for stocks in the Northeast Region into a single SAW reporting system. Similar consideration should also be given to including comparable reporting by ASMFC for stocks within State waters into the SAW reporting system.

The "merger" of the present SAW reports, the NEFSC "Status of the Stocks" reports, and possibly the comparable ASMFC reports could, however, create some additional burden on the overall process. The stock assessment summaries included in the SAW reports have all been peer reviewed by the SARC, whereas the information contained in the NEFSC "Status of the Stocks" has sometimes only been subjected to internal NEFSC review. On the assumption that all scientific information to be included in future "merged" SAW reports should continue to be peer reviewed, two possibilities might be considered:

1) Assess or review each stock every year: If the intent is to produce an annual SAW report or set of reports containing detailed assessment results (and management advice) or summaries of stock status for all of the 39 or more species/stocks in the Region, then provision would have to be made for some type of peer review of each assessment (whether it be a benchmark, update, or exploratory type) or stock status summary. This could impose a considerable increase in workload for the assessment scientists (mainly within the NEFSC) and the SARC. However, some relief could be achieved, at least at the SARC level, if part of the peer-review burden were delegated to review panels.

2) Assess or review each stock every 3 years: If the intent is not to assess and provide management advice on all (or most) stocks every year, but perhaps only at 3-year intervals, then 12-14 assessments spread over two or three SARC meetings per year would constitute the workload. Under this option, the annual SAW report(s) would only include the results and advice for the stocks considered in that year.

### Expanded Participation

Two main issues in improving the SAW process are staffing and funding. There is currently a deficiency in the number of non-NEFSC participants (e.g., State, academic, and other national and international experts) attending Subcommittee (Working Group) and SARC meetings. These meetings provide excellent training for State personnel in particular, and State directors must be encouraged to urge and/or allow their experts to attend. Industry representation is also desired and needs to be encouraged. Although Canadian scientists have participated in meetings of both the Subcommittees (when stocks of interest to Canada are being assessed) and the SARC, joint assessments with Canada of transboundary stocks may further increase the pool of experts.

The possibility of subsidizing the participation of more State people with ASMFC or Federal funds needs to be explored further. Covering the cost of hotel accommodation for State people attending Working Group and SARC meetings in Woods Hole (e.g., using MBL's Swope Center facilities) and holding meetings at different locations in the Region are two possible ways to make participation by State personnel more affordable.

### Consultants and External Advice

A pool of experts (national and international), from which to obtain external participants for Working Group meetings, SARC meetings, or independent reviews as necessary could be established. Such experts could be engaged on a retainer basis for a specified number of days per year (e.g., 20) to be called upon on as needed or could be simply be on a list to be contacted and engaged only when needed and available. This pool could include experts nominated by the fishing industry so long as potential conflicts of interest were avoided.

Requesting advice from the International Council for the Exploration of the Sea (ICES) and having assessments done by ICES Working Groups and the peer review and formulation of advice handled by the ICES Advisory Committee on Fishery Management (ACFM) is a possibility. The US, as an ICES contracting party, has the right to make such a request. However, this would create a significant additional workload for ICES, with financial implications to the ICES budget (and to the US monetary contribution). There is also the potential to use the NAFO Scientific Council peer-review process. However, the US position relative to its ultimate role in NAFO and whether and how the "machinery" of that organization might somehow be used in the assessment and management of US fishery resources within the NAFO Convention Area is still under consideration.

### Funding Support

A process for funding external experts (see above) and a process for verifying their qualifications should be established and implemented. A funding pool would be needed to cover not only travel and per diem expenses for qualified external experts, but in some cases (e.g., for independent consultants, academics, scientists from privately funded laboratories) consulting fees, retainers, or honoraria. The sources for funds for such a pool would presumably have to be NMFS (NEFSC and NER), ASMFC, and the two Councils. The NEFSC has traditionally provided funds for travel expenses and per diem for academic participants at SARC meetings, and ASMFC has similarly covered the costs for the State participants (usually three).

### Joint Assessments with Canada

Joint assessments with Canada would be done at the Working Group level. For example, a joint Working Group on Georges Bank Cod, Haddock, and Yellowtail Flounder could be established. Such a Working Group would produce assessments (without management advice) which would benefit from using common data sets, being done concurrently, and employing similar analytical methods and computations. Management advice would continue to be produced separately in each country (i.e., via the Regional Assessment Process or RAP in Canada and the SARC in the US). The early establishment and implementation of such joint Working Groups would be useful.

### Expanding the Geographic Scope

Expanding the geographic scope of the SAW process to include the Southeast Region would be beneficial from the point of view of the infusion of additional expertise. The focus of a coast-wide SARC could initially be on shared stocks. Possible issues concerning the expansion of the geographic scope may include administrative load, control complications, workload, practicality, and parochialism. There is currently no peer-review process like the SAW in the Southeast and it is uncertain how that Region would feel about a coast-wide process. It will, therefore, be necessary to ascertain the extent of any possible interest within the Southeast Region (including the NMFS Southeast Region and Fisheries Science Center, the South Atlantic and Gulf Fishery Management Councils, and the Gulf States Marine Fisheries Commission) for a coastwide SAW process.

### SAW Presentations

SAW presentations at Public Review Workshops have generally been poorly understood/received by the audience because of being too technical, complicated, and/or long and consequently are in need of some restructuring. With the benefit of an advance distribution of the SARC reports to Council members, coupled with an appropriate press release, a presentation focusing mainly on the management advice for each stock followed by a question-and-answer session, making use of a panel of experts (e.g., Subcommittee/Working Group Chairmen) would be a great improvement and a possible remedy. Such an approach was used for the SAW-23 Public Review Workshop sessions and appeared to be relatively successful.

## SARC Recommendations

Research recommendations have traditionally been included as part of the assessment report for each species contained in the "*SARC Consensus Summary of Assessments*" reports. There is great concern that most of these recommendations rarely reach fruition and hence result in a lack of forward movement in improving assessments.

The failure for most of the recommendations to be acted upon and followed to completion has been due to several reasons. In many cases, no thought has been given to listing the recommendations in an order of priority in the report. Secondly, the recommendations are merely stated and not necessarily drawn to the attention of particular researchers, research organizations or agencies, or funding sources. Lastly, budgetary or staffing limitations have generally prevented either the NEFSC or any State agencies from initiating the recommended research activities.

In the future, all research recommendations for each species need to be listed in order of priority in the "*SARC Consensus Summary of Assessments*" reports. Furthermore, a list of all potential funding sources needs to be generated, identifying, if possible, the type(s) of research typically funded by each source. With such a list available, future research recommendations, in addition to being prioritized, could also mention the potential funding source.

On the basis of research recommendations prioritized by the scientists and linked to potential funding sources, the SAW Steering Committee would be in position to evaluate all such recommendations for all species from a given SAW, develop an "approved" list of projects to be funded, and take further steps, as necessary and appropriate, in an attempt to secure the actual funding.

## ASMFC Peer-Review Process

There has been discussion within the ASMFC Management and Science Committee relative to improving the ISFMP stock assessment peer-review process. ASMFC, as a partner in the SAW process, should be encouraged to not focus its efforts totally on developing/improving an entirely separate process, but rather seek ways to strengthen and further blend its own process with that of the SAW. A subcommittee of the Management and Science Committee has been tasked with modifying a draft report on this matter.

## Interim SAW Process

Until modifications to the present SAW process are agreed and implemented, a number of relatively easy changes can be made, beginning with the Public Review Workshop sessions for SAW-23.

Information on the "latest scientific advice" will be provided in a press release to be prepared by the NEFSC Research Communications unit.

The SARC reports will be distributed to Council members in advance of the Public Review Workshop sessions.

Presentations at the Workshop sessions will be shortened, focus primarily on a quick review of the stock status and management advice, and be followed by questions and answers.

SARC Subcommittees will be renamed "Working Groups" and a joint US/Canada Working Group will be organized as soon as possible to assess the transboundary stocks of Georges Bank cod, haddock, and yellowtail flounder for SAW-24. The US membership of this joint Working Group will, as in the past, be open to representatives from the two Councils, States, and academia. Efforts will be made to broaden the participation in the Working Group and SARC meetings for SAW-24 by experts from States, as well as academia and other NMFS Science Centers.

Terms of reference for stocks for SAW-24 will specify whether an updated or new assessment is required. In the case of the assessments identified as "updates" (e.g., summer flounder, scup), the relevant sections of the SAW-24 "*SARC Consensus Summary of Assessments*" will be shortened by including only essential text and supporting material needed to describe new data points and current results. The usual repetition of "boiler-plate" text, tables, and figures contained in previous reports will be replaced by references to previous reports, as necessary

## The Next Step

The ideas and proposals contained in this issue paper require further thought and development. This paper should be circulated for review and discussion in various fora within the partner entities in the Northeast SAW process (i.e., NMFS, Councils, and ASMFC). The concept of an Atlantic Coast SAW has to be presented for consideration to the equivalent entities in the NMFS Southeast Region. An East Coast Working Group will then need to be established to further explore and develop the various options noted in this paper, as well as any others which are proposed as a result of the review and discussion noted above, and prepare a final position paper recommending specific modifications to the SAW process. This paper would then be used to garner support at the national NMFS level and with other potential funding bodies.

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