Northeast Fisheries Science Center Reference Document 01-04

The 32nd Northeast Regional Stock Assessment Workshop (32nd SAW)

Public Review Workshop

April 2001

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A Report of the 32nd Northeast Regional Stock Assessment Workshop

The 32nd Northeast Regional Stock Assessment Workshop (32nd SAW)

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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OVERVIEW

Introduction

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

The Advisory Report is presented to the public via a series of Public Review Workshops, described below. Subsequent to the Workshops, the draft Advisory Report is finalized and folded into a larger document known as the Public Review Workshop Report. The Report also includes a summary of any meetings of the SAW Steering Committee (consisting of the Region's executives and responsible for policy and scheduling decisions) that may have occurred during the SAW cycle.

This is the Public Review Workshop Report for SAW 32 and the 32nd SARC and includes the final version of the Advisory Report and a report from a February 13-14, 2001 meeting of the SAW Steering Committee.

SAW 32 reviewed assessments for Gulf of Maine-Georges Bank American plaice, sea scallop, silver hake, and Gulf of Maine haddock. The four stocks were peer reviewed by the 32nd Stock Assessment Review Committee (SARC) at its November 27-December 1, 2000 meeting in Woods Hole, MA. The Public Review Workshop of the 32nd Northeast Regional Stock Assessment Workshop (SAW 32) was held in two sessions. The first was at a meeting of the New England Fishery Management Council on January 25. The second was at a meeting of the Mid-Atlantic Fishery Management Council on February 7.

Copies of the SAW 32nd draft *Advisory Report on Stock Status* and SAW 32 draft *Consensus Summary of Assessments* had been distributed to members of each Council or Board prior to the Workshops.

The SAW Chairman, Dr. Terry Smith of the Northeast Fisheries Science Center (NEFSC), NMFS, conducted both Council Workshops.

Status Summaries

Gulf of Maine-Georges Bank American Plaice

The stock is not overfished but overfishing is occurring. Fully-recruited fishing mortality rate has declined in recent years but is still above the maximum fishing mortality rate threshold. Spawning stock biomass (SSB) in 1999 (14,100 mt) is above the minimum stock size threshold but below the long term average (16,800 mt). Recruitment in 1994-1997 was below average; the 1998 year class is above average. Fishing mortality rates should be reduced which will allow the stock to rebuild more quickly. Strategies for reducing discarding in both small and large mesh fisheries will improve the yield potential for this stock.

<u>Sea scallop</u>
Sea scallops are assessed as two component stocks: Georges Bank and Mid-Atlantic Bight. The Georges Bank portion of the stock is not overfished nor is overfishing occurring. Biomass in 2000 is above the biomass target level and 1999 fishing mortality rate is below the maximum fishing mortality rate threshold. The Mid-Atlantic Bight portion of the stock is not overfished but overfishing is occurring. Biomass in 2000 is slightly below the biomass target level but 1999 fishing mortality rate (F = 0.43) was above the maximum fishing mortality rate threshold (F = 0.24). Recruitment in both areas has improved with the recruitment on Georges Bank in 2000 the highest observed. Managers should reduce the fishing mortality rate in the Mid-Atlantic region and consider timely additional closures to prevent growth overfishing of concentrations of recruiting animals.

<u>Silver hake</u>
The silver hake stock is managed and assessed as two stock components - northern and southern.. Current fishing mortality rates could not be determined for either component. The northern component is not overfished relative to a survey biomass threshold index (13.08 versus a threshold of 3.31 kg/tow). The southern component is overfished (0.78 kg/tow versus a threshold of 0.89 kg/tow). There is indication of a relative shift in biomass in favor of the northern area. That area now contains 80% of the total stock biomass. According to the current overfishing definition fishing mortality for the southern stock component should be set to 0. Stock-wide the issue of discarding in small mesh fisheries should be addressed.

<u>Gulf of Maine haddock</u>
The Gulf of Maine haddock stock is overfished. The current exploitation rate index (0.246) is below the maximum fishing mortality rate threshold but current biomass (3.41 kg/tow) is below the minimum biomass threshold (4.39 kg/tow). Exploitation rates have declined in the 1990s and are currently among the lowest on record. Survey abundance and biomass indices have increased from record low levels in the 1990s and there is evidence of some broadening of the age structure. Recent recruitment has improved with evidence that strong 1998 and 1999 year classes will recruit to the fishery in 2001-2003. Reductions in fishing mortality will promote further increases in stock biomass and further broadening of the age structure. The historic core of the Gulf of Maine haddock distribution is in the vicinity of the current Western Gulf of Maine closure and continued closure will assist in protecting the stock.

ADVISORY REPORT ON STOCK STATUS

INTRODUCTION

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

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

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

Since there are two dimensions to the status of the stock – the rate of removal and the biomass level – it is possible that a stock not currently subject to overfishing in terms of exploitation rates is in an overfished condition, that is, has a biomass level less than the threshold level. This may be due to heavy exploitation in the past, or a result of other factors such as unfavorable environmental conditions. In this case, future recruitment to the stock is very important and the probability of improvement is increased greatly by increasing the stock size. Conversely, fishing down a stock that is at a high biomass level should generally increase the long-term sustainable yield. This philosophy is embodied in the Sustainable Fisheries Act — stocks should be managed on the basis of maximum sustainable yield (MSY). The biomass that produces this yield is called B_{MSY} and the fishing mortality rate that produces MSY is called F_{MSY}.

Given this, stocks under review are classified with respect to current overfishing definitions. A stock is overfished if its current biomass is below $B_{THRESHOLD}$ and overfishing is occurring if current F is greater than $F_{THRESHOLD}$.

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

			BIOMASS	
		B $< B_{THRESHOLD}$	$B_{THRESHOLD} <$ **B** $< B_{MSY}$	**B** $> B_{MSY}$
EXPLOITATION	$F_{THRESHOLD}$	$F_{THRESHOLD} = 0$ or F min (The minimal achievable mortality rate.)	$F_{THRESHOLD} <$ FMSY (The maximum mortality rate that defines overfishing at various levels of biomass.)	$F_{THRESHOLD} = F_{MSY}$
RATE	F_{TARGET}	$F_{TARGET} = 0$ or F min (The minimal achievable mortality rate.)	$F_{TARGET} < F_{THRESHOLD}$ (Where F_{TARGET} is chosen to minimize the risk of exceeding $F_{THRESHOLD}$)	$F_{TARGET} < F_{MSY}$

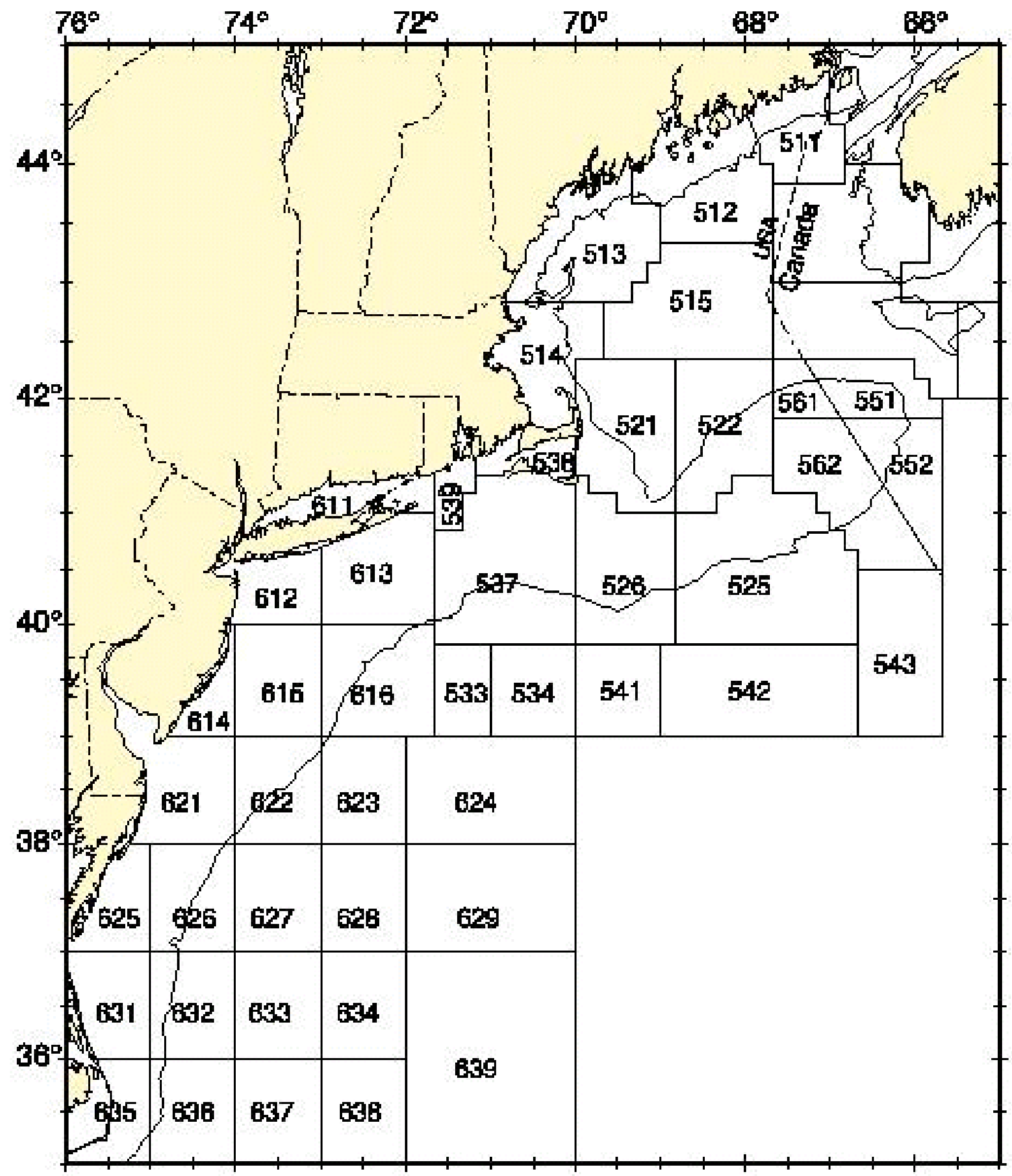


Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

GLOSSARY OF TERMS

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

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

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

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

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

Biomass Dynamics Model. A simple stock assessment model that tracks changes in stock biomass rather than numbers. Biomass dynamic models employ assumptions about growth (in weight) and can be tuned to abundance data such as commercial catch rates, research survey trends or biomass estimates.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Growth overfishing: The situation existing when the rate of fishing mortality is above F_{MAX} and when the loss in fish weight due to mortality exceeds the gain in fish weight due to growth.

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

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

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

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

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

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

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

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

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

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

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

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

Recruitment overfishing: The situation existing when the fishing mortality rate reaches a level that causes a significant reduction in recruitment to the spawning stock. This is caused by a greatly reduced spawning stock and is characterized by a decreasing proportion of older fish in the catch and generally very low recruitment year after year.

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

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

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

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

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

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

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

Survival Ratios. Ratios of recruits to spawners (or spawning biomass) in a stock-recruitment analysis.

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

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

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

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

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

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

A. GULF OF MAINE-GEORGES BANK AMERICAN PLAICE ADVISORY REPORT

Status of Stock: The Gulf of Maine-Georges Bank American plaice stock is not overfished but overfishing is occurring. Fully recruited fishing mortality declined from a record high of 0.65 (44% exploitation) in 1992 to 0.27 (22% exploitation) in 1999 (Figure A1), above the maximum fishing mortality rate threshold of F =0.19. Spawning stock biomass (SSB) in 1999 was 14,100 mt, above the minimum biomass threshold of 6,050 mt. SSB is below the long term average (16,800 mt) (Figure A2). Assuming that the 1999 fishing mortality rate was maintained in 2000, SSB is projected to increase to 16,700 mt in 2001. The recruiting year classes in 1994-1997 (1995-1998 at age 1) have been below average, however, the 1998 year class is estimated to be above average.

Amendment 9 established a biomass threshold of 1/4 of the average SSB at F0.1 (estimated to be 6,050 mt) (Figure A7). The control rule defines target F as 60% of the F_{MSY} proxy of $F_{0.1}$ when SSB is greater than SSB_{MSY} and F would decrease linearly to zero at ½ SSB_{MSY}. SSB_{MSY} is estimated as 24,200 mt. MSY is estimated as 4,400 mt.

Management Advice: To conform to the Amendment 9 control rule in 2001, fishing mortality rate in 2001 should be reduced substantially ($F_{threshold}$ = 0.11; F_{target}= 0.04). Lower fishing mortality rates will allow the stock to rebuild more quickly because of the larger 1997 and 1998 year classes. Discarding in both small and large mesh fisheries continues to reduce the yield potential for this stock. Managers should examine strategies for reducing discards

Forecast for 2000-2002: The forecasts for 2000-2002 (Figure A4) were based on VPA-calibrated 1999 stock sizes. Projections were performed for $F_{0.1}$ = 0.19, F_{99} = 0.27, $F_{longterm\_target}$= 0.11 and F_{2001_target} = 0.04. Recruitment at age 1 in 2000-2002 was estimated from re-sampling of the distribution of the final VPA estimates of the 1979-1998 year classes.

Forecast Table: F_{2000} = 0.27 Basis: F_{99} from VPA in 2000; SSB estimated to be 14,100 mt in 1999. Average 1995-1999 partial recruitment and mean weights at age, and 1998-2000 maturation ogive (weights in 000's mt).

2000			2001			2002	Consequences/Implications
Landings	SSB	$F_{2001-2002}$	Landings	Discards	SSB	SSB	
3.7	16.1	F_{99} = 0.27	3.8	0.5	16.7	17.8	SSB in 2002 increases to 74% of SSB_{MSY}. Landings remain near record low values.
		$F_{0.1}$ = 0.19	2.7	0.4	17.1	19.4	SSB in 2002 increases to 80% of SSB_{MSY}. Landings remain near record low values.
		$F_{longterm\_target}$ = 0.11	1.6	0.2	17.4	21.0	SSB in 2002 increases to 87% of SSB_{MSY}. Landings reach record low value.
		F_{2001_target} = 0.04	0.6	0.1	17.7	22.6	SSB in 2002 increases to 93% of SSB_{MSY}. Landings reach record low value.

Catch and Status Table (weights in ‘000 mt. Recruitment in millions): Gulf of Maine-Georges Bank American plaice

Year	1993	1994	1995	1996	1997	1998	1999	2000[4]	Max[3]	Min[3]	Mean[3]
Total commercial landings	5.7	5.1	4.6	4.4	4.0	3.6	3.3	3.7	15.2	2.4	6.5
US commercial landings	5.7	5.1	4.6	4.4	3.9	3.7	3.1	3.7	15.1	2.4	6.5
Canada commercial discards	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.0	<0.1
Discards	2.0	1.6	3.0	0.8	0.9	0.7	0.7	0.5	3.0	0.2	0.9
US recreational landings[1]	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Catch used in assessment	7.7	6.7	7.7	5.2	4.8	4.3	3.8	—	15.5	2.9	7.7
Spawning stock biomass[2]	12.4	12.2	11.0	12.5	14.4	15.4	14.1	16.1	46.6	7.4	16.8
Recruitment (age 1)	50.1	41.9	24.4	24.2	13.1	27.5	34.5	14.2[5]	53.4	13.1	30.5
F (ages 5-8)	0.63	0.64	0.64	0.39	0.34	0.30	0.27	0.27	0.65	0.27	0.45
Exploitation rate	43%	43%	43%	30%	26%	24%	22%	22%	44%	22%	33%

[1]Not used in assessment. [2]At beginning of the spawning season (i.e., March 1). [3]Over period 1980-1999.
[4]Projected. [5]Estimated from VPA survey regression.

Stock Identification and Distribution: The Gulf of Maine-Georges Bank American plaice stock is distributed along the continental shelf from southern Labrador to Long Island, New York. In US waters, plaice are most abundant in the deeper (>50 m) waters of the Gulf of Maine and off the northern edge of Georges Bank. Although growth varies between the Gulf of Maine and Georges Bank, all American plaice from these areas are considered to represent a unit stock

Catches: Commercial landings increased in the mid 1970s and early 1980s, peaking at a record high 15,000 mt in 1982. During 1983-1989, landings declined but subsequently increased through 1992. Landings have declined each year since 1992 and were 3,300 mt in 1999 (Figure A1). Discards represented 15-20% of the total catch during 1996-1999.

Data and Assessment: An analytical assessment (VPA using ADAPT) of commercial landings-at-age data and discards at age data from the large mesh otter trawl fleet and the northern shrimp fishery was conducted. Information on recruitment and abundance was taken from standardized NEFSC and Massachusetts Division of Marine Fisheries (MADMF) spring and autumn survey catch-per-tow-at-age data. The uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1999 were evaluated (Figures A5 and A6).

Fishing Mortality: Fishing mortality rate trends are shown in Figure A1. The current fishing mortality rate (1999) is 0.27 (22% exploitation), approximately 50% of the peak value observed in the early to mid-1990s. There is an 80% probability that the average F in 1999 was between 0.23 and 0.30 (Figure A5). There is a 100% probability that F in 1999 was above maximum fishing mortality rate threshold of $F_{0.1}$ = 0.19.

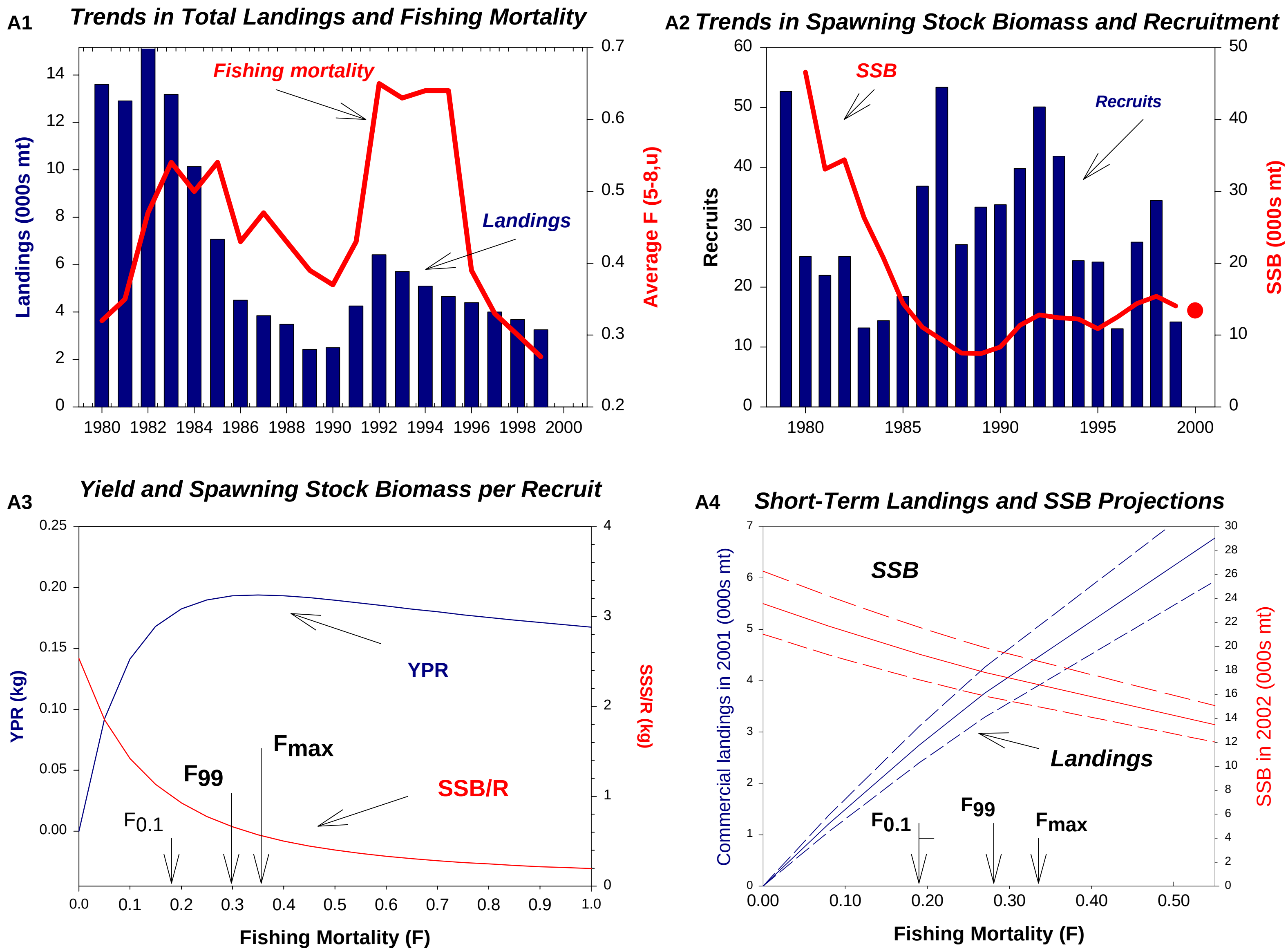
Recruitment: Strong year classes were produced in 1979, 1987 and 1992 (Figure A2). The 1993 year class and the 1998 year class are the most recent above average year classes.

Spawning Stock Biomass: The long-term average SSB is 16,700 mt. SSB declined by 84% between 1980 (46,600) and 1989 (7,400 mt) and then increased to 12,800 mt in 1992, and has since remained relatively stable. SSB was 14,100 mt in 1999 (Figure A2) and is projected to increase in 2000 and 2001 under status quo or lower fishing mortality rates. There is an 80% probability that the 1999 SSB is between 12,400 mt and 15,700 mt (Figure A6). There is a 100% probability that SSB is above the minimum SSB threshold of 6,050 mt.

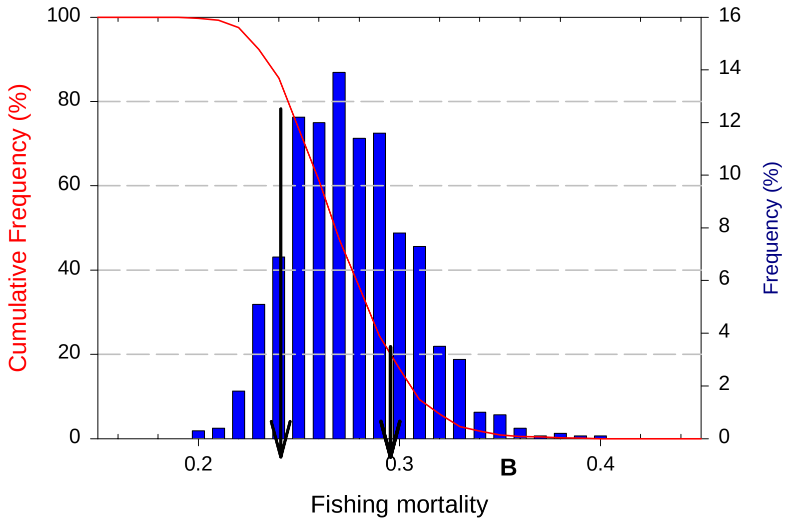
Biological Reference Points: Yield and SSB per recruit analyses updated in 1998 (SAW28) with an assumed M of 0.20 indicate that F_{01}= 0.19 (16% exploitation), and F_{max}= 0.35 (27% exploitation) (Figure A3). Based on SSB per recruit and long term average recruitment, a proxy for Bmsy is estimated as 24,2000 mt (SSBmsy) and a proxy for MSY as 4,400 mt.

Special Comments: In this stock in particular, improved sea sampling is important since discards remain a significant fraction (10%-60% by number, and 2%-40% by weight during 1980-1999) of total catch.

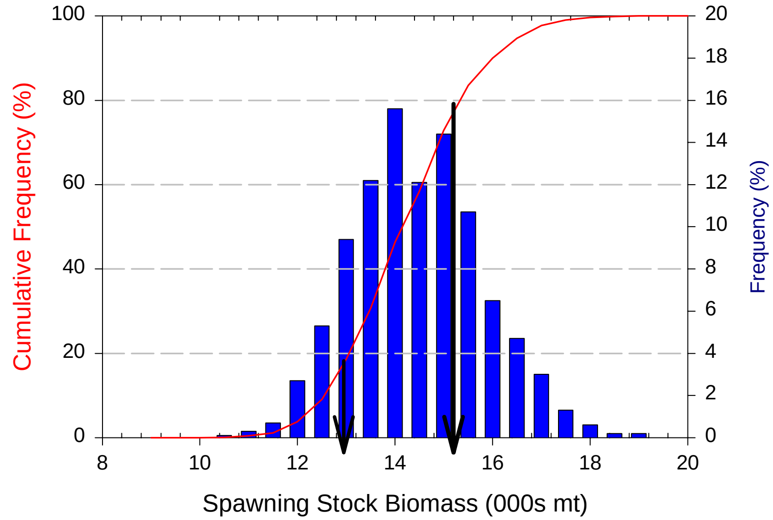
Source of Information: Report of the 32nd Stock Assessment Workshop (32nd SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 00-05.


A1
Trends in Total Landings and Fishing Mortality
Fishing mortality
Landings
Landings (000s mt)
Average F (5-8,u)
A2
Trends in Spawning Stock Biomass and Recruitment
SSB
Recruits
Recruits
SSB (000s mt)
A3
Yield and Spawning Stock Biomass per Recruit
YPR
SSB/R
YPR (kg)
SSB/R (kg)
F0.1
F99
Fmax
Fishing Mortality (F)
A4
Short-Term Landings and SSB Projections
SSB
Landings
Commercial landings in 2001 (000s mt)
SSB in 2002 (000s mt)
F0.1
F99
Fmax
Fishing Mortality (F)

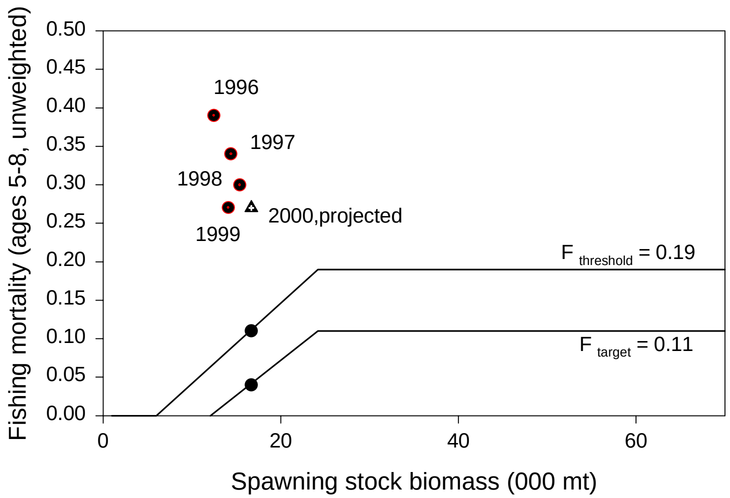
A5 *Precision of 1999 F Estimate*



A6 *Precision of 1999 SSB Estimate*



A7 *Proposed Control Rule and Recent Stock Status*



B. SEA SCALLOP ADVISORY REPORT

Status of Stock: Sea scallop were assessed as two stocks: Georges Bank (Figure B13) and Mid-Atlantic Bight (Figure B14).

Georges Bank: Sea scallops are not overfished and over fishing is not occurring. Biomass in 2000, as measured by the NEFSC scallop research surveys, is above the B_{MAX} target level (a proxy for B_{MSY}, Figure B2). Biomass in Georges Bank closed areas in 1999 was 80% of the total biomass in the management are. The estimated fishing mortality rate in 1999 (0.14) was below the $F_{MAX} = 0.24$ threshold (Figures B9).

Mid-Atlantic: Sea scallops are not overfished but over fishing is occurring. Biomass in 2000 is slightly below the B_{MAX} target level (Figure B3) but above the threshold level. The estimated fishing mortality rate during 1999 (0.42) was above the F_{MAX} threshold level (Figure B4).

There is evidence that recruitment in both areas has improved (Figure B5) and recruitment indices for Georges Bank in 2000 are the highest observed in the time series.

Fishing mortality rates were determined on a whole stock basis for status determination purposes. This approach may no longer be the best way of determining stock status given area management (*see Special Comments*).

The FMP control rule (Figure B6) states that when biomass exceeds B_{MAX} the proxy for B_{MSY}, the over fishing threshold is F_{MSY}. Target fishing mortality is 80% of the threshold rate. Below B_{MAX}, threshold F decreases linearly to zero when stock size is below the biomass threshold of 1/4 B_{MAX}.

Management Advice: Reduce fishing mortality in the Mid-Atlantic region to end over fishing. Given evidence of improved recruitment in some currently open areas, managers should consider additional timely closure to prevent growth over fishing of these concentrations.

Forecast for 2000: No forecasts were performed.

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

US Landings (mt meats)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999[1]	Min[2]	Max[2]	Mean
Georges Bank[3]	9,311	8,238	3,655	1,137	982	2,045	2,326	2,016	5,155	982	9,982	4,577
Mid-Atlantic Bight	7,011	4,955	2,778	5,872	6,318	4,999	2,910	2,948	4,653	16,10	7,973	4,770
Other[4]	676	846	864	525	665	773	699	600	338	338	1,138	676
US Total	16,999	14,039	7,296	7,534	7,965	7,818	5,936	5,565	10,146	5,565	17,107	10,024

[1]Preliminary. [2] 1982-1999. [3] US portion of Georges Bank. [4] Includes Gulf of Maine, Southern New England, and other US areas

Survey Trends for Recruit Abundance (NMFS survey, population numbers per tow, adjusted for survey dredge selectivity)

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000	Min[5,6]	Max[5,6]	Mean[5,6]
Georges Bank[7]	170.8	44.7	15.8	92.9	71.3	25.4	143.0	57.4	427.6	13.7	427.6	96.2
Mid-Atlantic Bight[7]	19.9	130.0	56.0	70.7	10.5	25.9	120.7	122.6	83.0	6.0	130.0	55.7

[5] 1981-2000 for Georges Bank. [6]1979-2000 for Mid-Atlantic Bight. [7] Recruits 40-72 mm shell height on Georges Bank and 40-69 mm shell height in the Mid-Atlantic Bight, based on one year's estimated growth starting at 40 mm from a von Bertalanffy equations

Survey Trends for Stock Abundance (NMFS survey, population numbers per tow, >40 mm shell height)

Year	1992	1993	1994	1995	1996	1997	1998[8]	1999[8]	2000[8]	Min[4,5]	Max[4,5]	Mean[4,5]
Georges Bank	79	23	25	29	78	81	176	178	369	23	369	77
Mid-Atlantic Bight	29	26	68	93	54	26	49	131	240	19	240	62

[8]Includes 'non-random' tows in closed areas.

Fishing Mortality (annual instantaneous rates, rescaled catch-biomass method)

Year	1991	1992	1993	1994	1995	1996	1997	1998	1999	Min[2]	Max[2]	Mean[2]
Georges Bank	1.51	1.11	1.28	0.34	0.23	0.19	0.16	0.05	0.14	0.05	1.51	0.73
Mid-Atlantic Bight	1.31	1.54	1.12	1.20	0.95	1.12	0.92	0.69	0.43	0.43	1.54	1.00

Stock Distribution and Identification: Sea scallops are distributed from North Carolina to Newfoundland along the continental shelf of North America. In US waters sea scallops are found predominately in the Mid-Atlantic and Georges Bank regions. For assessment purposes, sea scallops in the Mid-Atlantic and Georges Bank areas are treated separately.

Catches: 17,107 mt during 1990 (Figure B1). On Georges Bank landings peaked in 1990, decreased due to poor stock condition and area closures, and then increased in 1999 when Closed Area II was reopened. Landings from the Mid-Atlantic region peaked in 1989 at 7,973 mt and then varied without trend and were near the long term mean (4,770 mt) during 1999.

Data and Assessment: The assessment approach used a rescaled catch-biomass method to estimate fishing mortality rates during 1982-1999. The rescaled approach combines an estimate of average fishing mortality rate from a survey-based method with estimates of trend from an un-scaled catch-biomass approach. Stock biomass levels were measured on a relative basis using NMFS survey data.

Biological Reference Points: Biological reference points implemented in Amendment 7 defined the proxy for B_{MSY} as B_{MAX} in terms of biomass (meat weight) per survey dredge tow, with values of 3.90 kg/tow in the Mid-Atlantic region and 8.16 kg/tow in the Georges Bank region. These values were calculated as biomass per recruit at F_{MAX}, multiplied by the median survey recruitment estimates. The proxy for F_{MSY} was set at F_{MAX}, determined to be 0.24 for both stocks (Figure B6). Biological reference points were not updated in this assessment (but see Special Comments section).

Fishing Mortality: In the Georges Bank stock region, fishing mortality rates for sea scallop averaged 1.0 during 1982-1993 and then declined to about 0.10 during 1998-1999 (Figure B4). In the Mid-Atlantic region, fishing mortality rates fluctuated without trend during 1982-1993 around a mean value of 1.1 and then declined to about 0.56 during 1998-1999 (Figure B4).

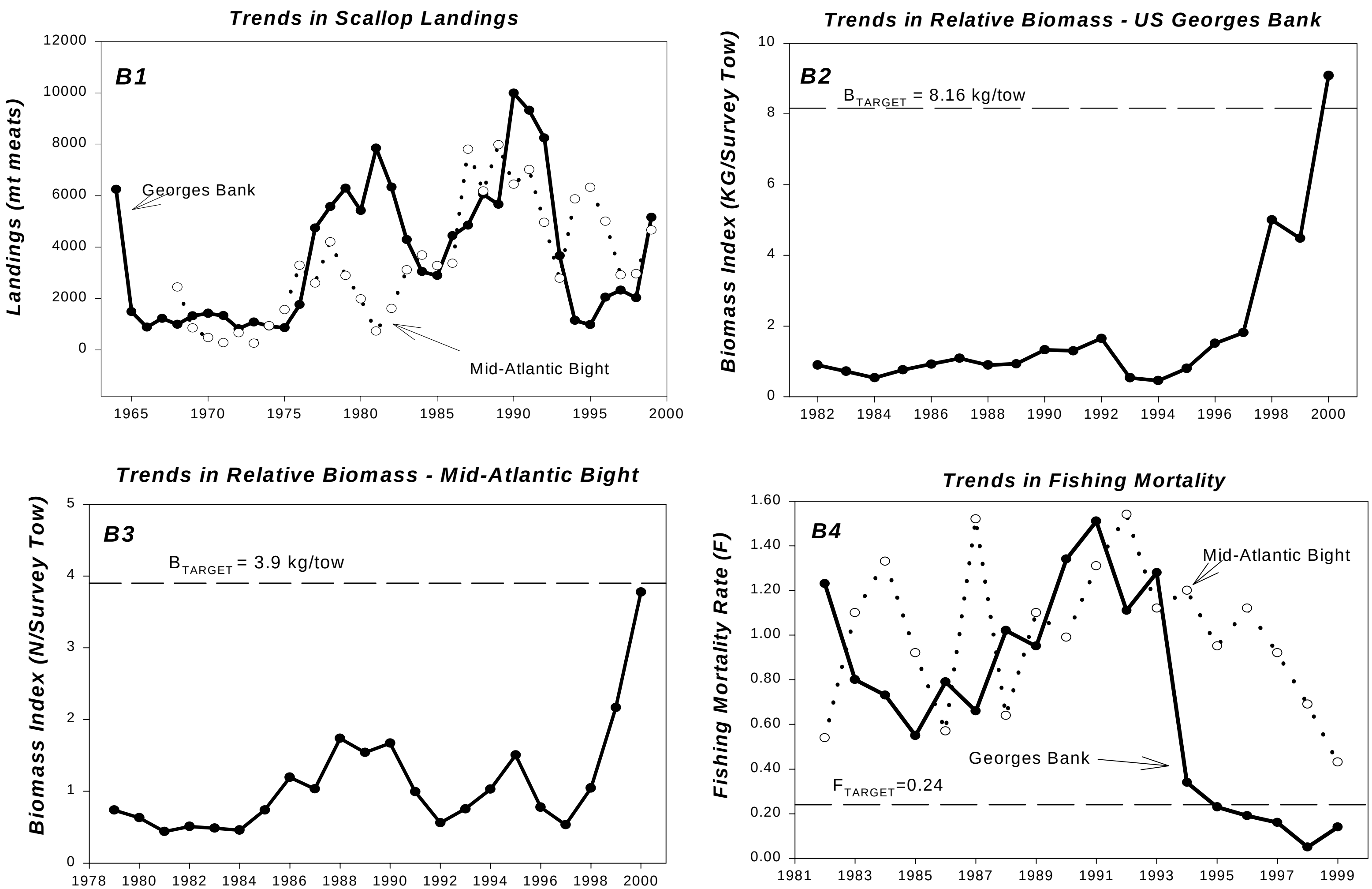
Recruitment: Recruitment in both areas has generally improved since 1997 and appears to have been very high on Georges Bank in 2000 (Figure B5).

Stock Biomass: Stock biomass trends were characterized by NMFS scallop survey data (Figures B2-B3). Biomass increased recently in all areas especially so in closed areas (Figures B7-B8). Stock biomass during 1999-2000 was at record highs for both stocks. During 1999-2000, closed areas accounted for about 80% of total biomass in the Georges Bank area (Figure B7) and about 50% of total stock biomass in the Mid-Atlantic Bight area (Figure B8).

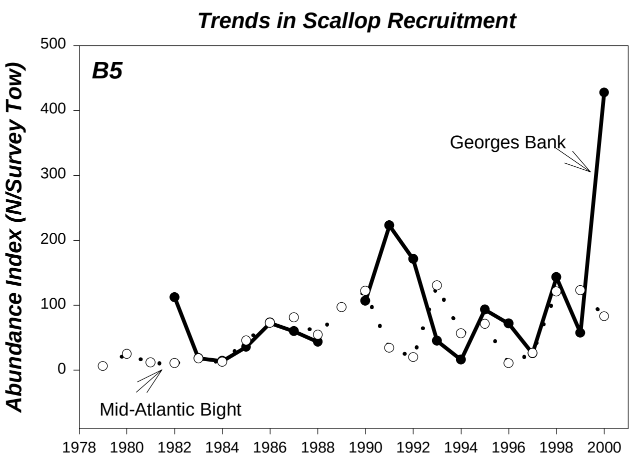
Special Comments: In the event that rotational management is implemented, it will be necessary to revise assessment methods and biological reference points (see Research Recommendations in Consensus Summary).

Whole stock fishing mortality rates may not be appropriate measures of fishing mortality for sessile stocks when there are rotational or other area closures. Fishing mortality rates that are spatially averaged over both open and closed areas do not necessarily give values that result in maximum yield-per-recruit. It may be more appropriate to average fishing mortality in a given area over several years. Such time-averaged fishing mortalities may be more appropriately compared to the yield-per-recruit reference point F_{MAX}.

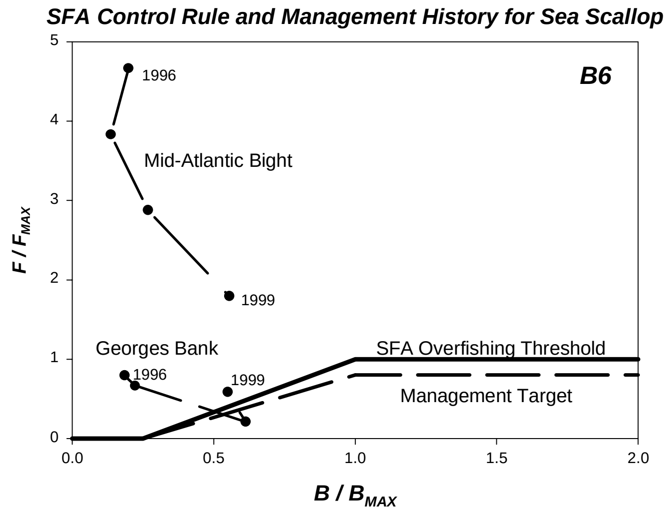
Sources of Information: Report of the 32nd Northeast Regional Stock Assessment Workshop (32nd SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 01-05.



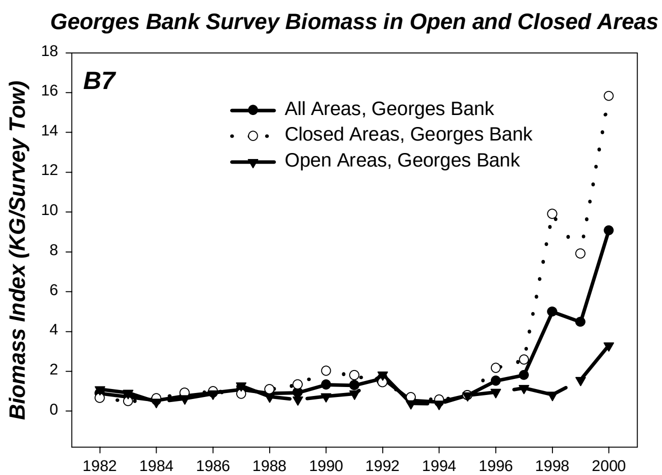
Trends in Scallop Landings
B1
Landings (mt meats)
Georges Bank
Mid-Atlantic Bight
Trends in Relative Biomass - US Georges Bank
B2
Biomass Index (KG/Survey Tow)
B TARGET = 8.16 kg/tow
Trends in Relative Biomass - Mid-Atlantic Bight
B3
Biomass Index (N/Survey Tow)
B TARGET = 3.9 kg/tow
Trends in Fishing Mortality
B4
Fishing Mortality Rate (F)
Mid-Atlantic Bight
Georges Bank
F TARGET=0.24



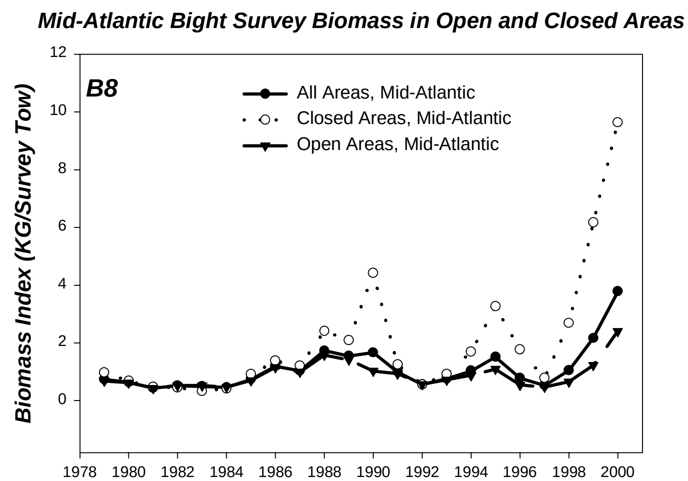
Trends in Scallop Recruitment
B5
Abundance Index (N/Survey Tow)
Georges Bank
Mid-Atlantic Bight
500
400
300
200
100
0
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000



SFA Control Rule and Management History for Sea Scallop
B6
F / F_{MAX}
B / B_{MAX}
1996
Mid-Atlantic Bight
1999
Georges Bank
1996
1999
SFA Overfishing Threshold
Management Target
5
4
3
2
1
0
0.0
0.5
1.0
1.5
2.0

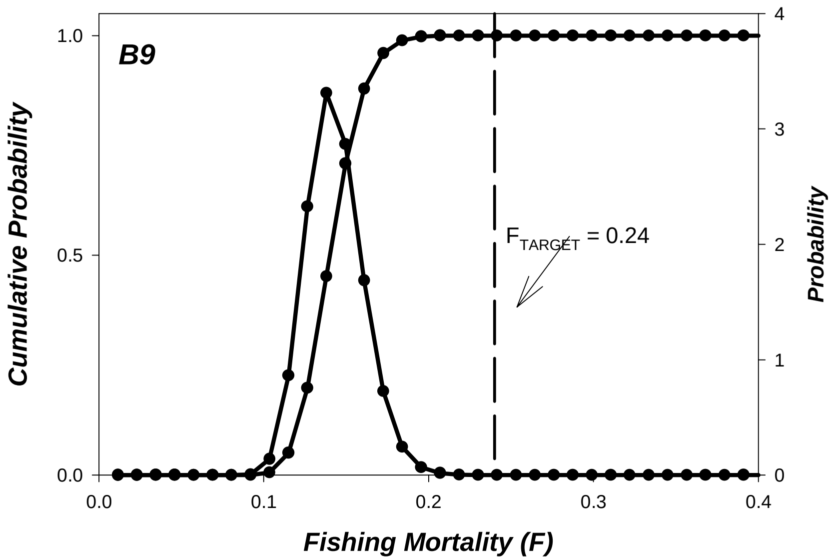


Georges Bank Survey Biomass in Open and Closed Areas
B7
Biomass Index (KG/Survey Tow)
All Areas, Georges Bank
Closed Areas, Georges Bank
Open Areas, Georges Bank
18
16
14
12
10
8
6
4
2
0
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

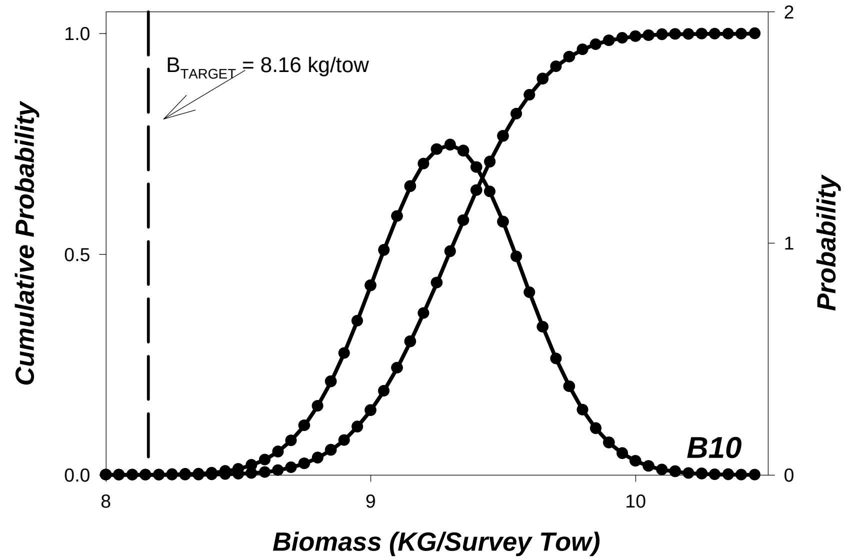


Mid-Atlantic Bight Survey Biomass in Open and Closed Areas
B8
Biomass Index (KG/Survey Tow)
All Areas, Mid-Atlantic
Closed Areas, Mid-Atlantic
Open Areas, Mid-Atlantic
12
10
8
6
4
2
0
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000

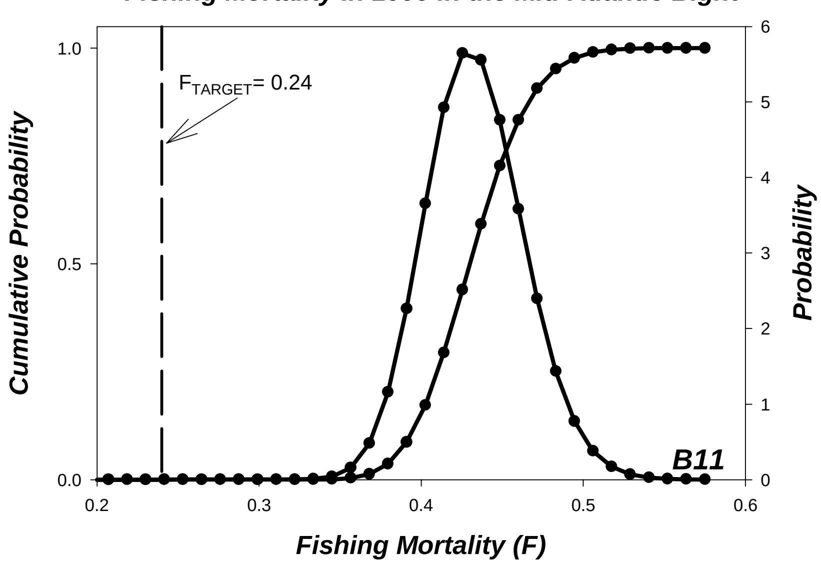
Fishing Mortality in 1999 on Georges Bank



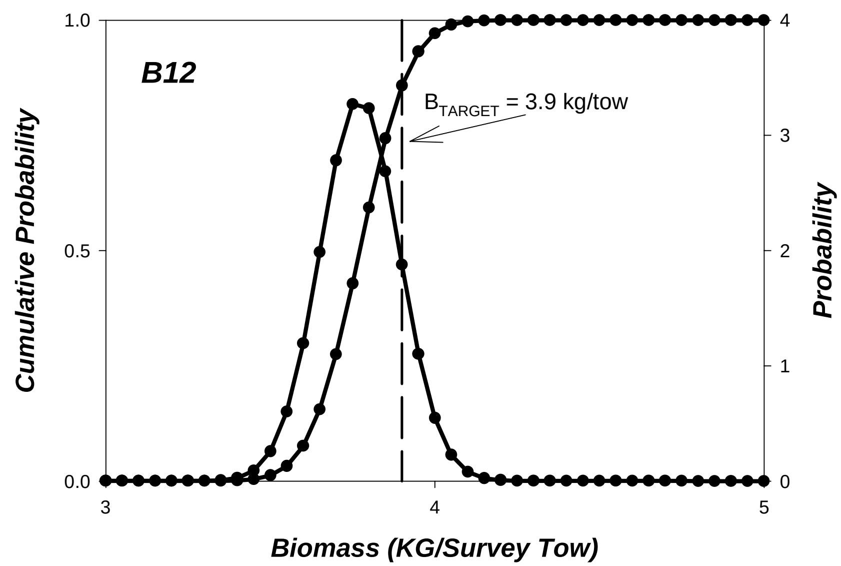
Biomass in 1999 on Georges Bank



Fishing Mortality in 1999 in the Mid-Atlantic Bight



Biomass in 1999 in the Mid-Atlantic Bight



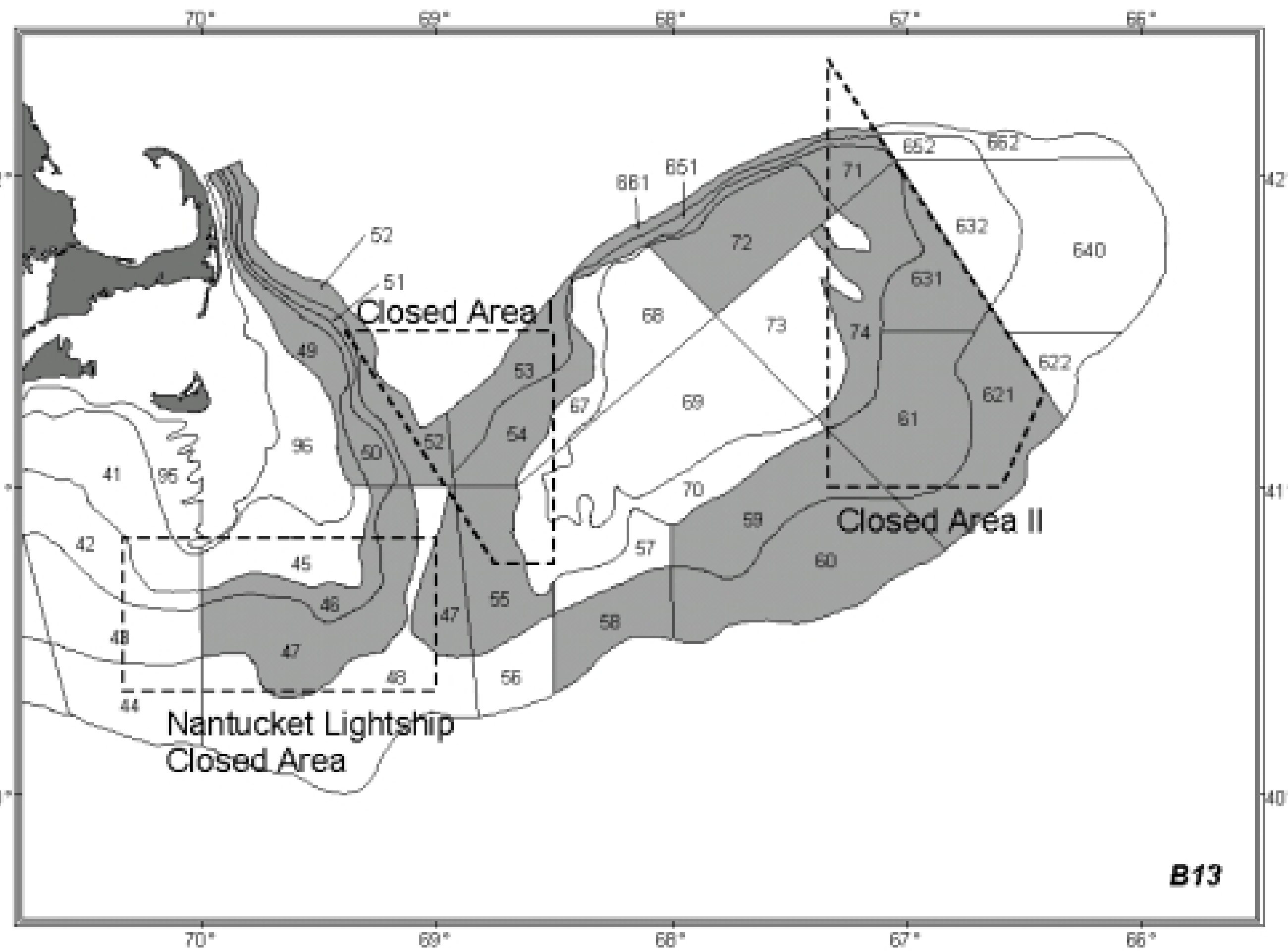


Figure B13. Georges Bank, sea scallop survey sampling strata and groundfish management closed areas.

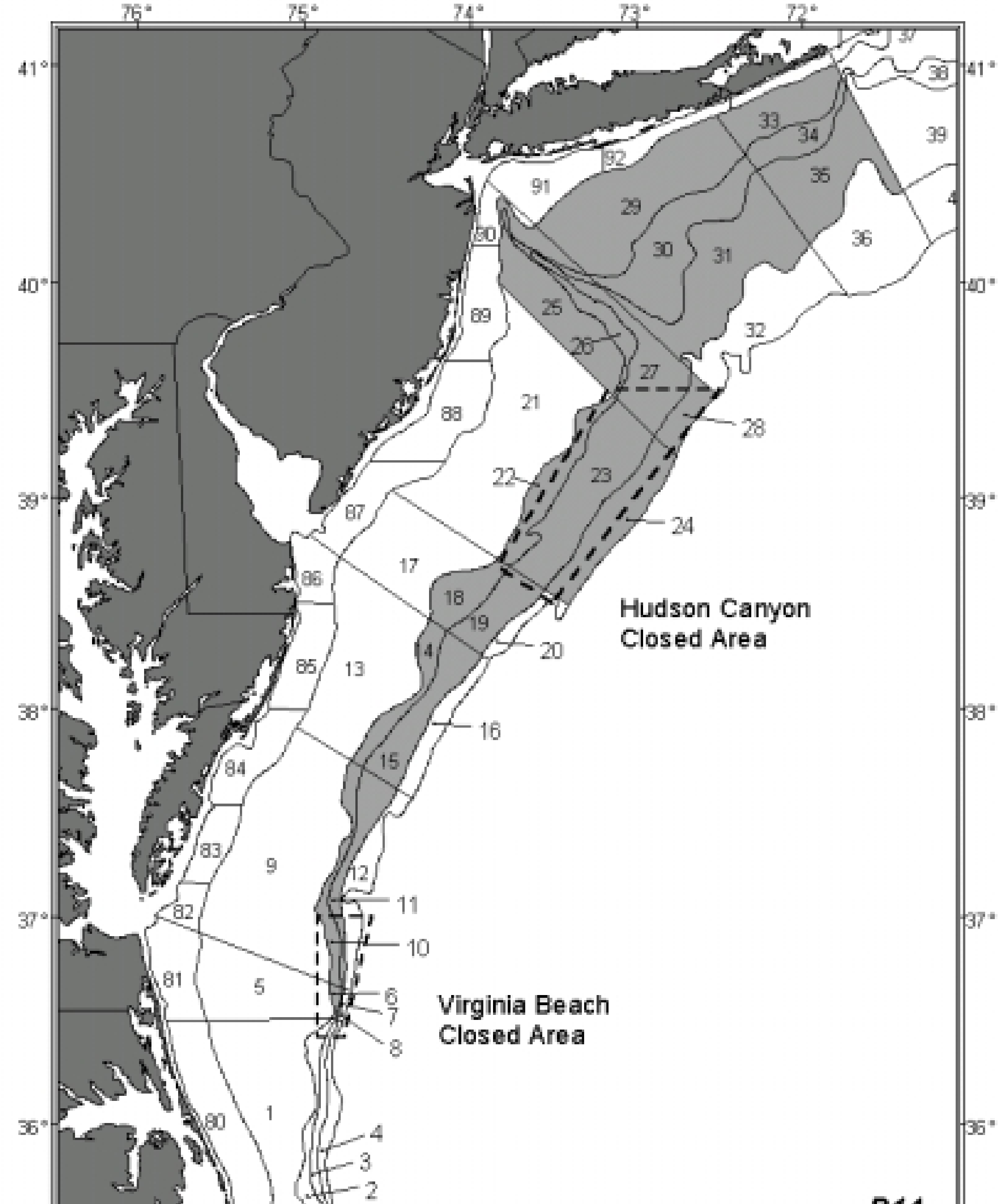


Figure B14. Mid-Atlantic Bight, including sea scallop survey sampling strata and scallop management closed areas.

C. SILVER HAKE ADVISORY REPORT

Status of Stock: Silver hake is managed and assessed as two stocks, a northern component and a southern component (Figure C5). Status determinations on biomass will be offered separately for each. The fishing mortality status of the silver hake resource remains unknown due to our inability to reconcile apparent low survival rate based on surveys with biomass trends and landings data**.**

Northern stock: According to the current overfishing definition, the stock is not overfished (13.08 kg/tow relative to a biomass threshold of 3.31 kg/tow). The survey biomass index was low through the early 1970s and has generally increased since the 1980s. The exploitation rate index has been low since the late 1970s.

Southern stock: According to the current overfishing definition the stock is overfished. Current biomass is indexed as 0.78 kg/tow relative to a biomass threshold of 0.89 kg/tow. The latter value is derived from a recomputation of the threshold (original value 0.78 kg/tow). The survey biomass indices have generally been decreasing since 1985. The exploitation rate index was high during the distant water fleet fishery of the 1960s-1970s and declined to low levels thereafter. There is some indication of increases in the exploitation rate index during the 1990s.

Relative biomass in the southern and northern areas has shifted in favor of the northern area which now accounts for about 80% of the sampled biomass, mostly due to reduction in biomass in the Mid-Atlantic and Southern New England portions of the southern management area. The change in distribution has occurred simultaneously with changes in ocean conditions, notably increasing temperature. It is possible that these events are related but large unreported catches, such as discards, could give the same pattern.

The proportion of older fish in both research vessel and commercial catches in now much lower than in earlier years. Some analytical approaches interpret this an indicative of an increase in the fishing mortality rate and declining biomass. Alternatively, older fish may not be sampled by either fishery because of changes in distribution of that stock component.

Area-wide, landings in more recent years are substantially lower than the period when an international fishery operated (1960s and 1970s). Analyses suggest the combined area biomass is large, relatively stable, and higher than in the 1970s, and that the exploitation rate is much lower than historically was the case**.**

Management Advice: According to the current overfishing definition, fishing mortality in the southern stock component should be set to 0. The problem of discards in small mesh fisheries needs to be addressed. At current levels of catch for the northern component, biomass has remained stable or increased.

Forecast for 2001: No forecasts were performed**.**

Catch and Status Table (weights in '000's of metric tons): Silver Hake

Northern Stock Area (1955-1999)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Max	Min	Mean
Landings	6.4	6.1	5.3	4.4	4.1	2.7	3.9	2.8	2.5	4.0	94.5	2.5	24.7
Discards[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Catch[2]	6.4	6.1	5.3	4.4	4.1	2.7	3.9	2.8	2.5	4.0	94.5	2.5	24.7
Biomass Index[3]	15.3	11.9	14.3	8.1	6.9	13.2	7.9	5.6	22.0	11.6	25.4[5]	2.0[5]	8.3[5]
Exploitation Rate Index[4]	0.42	0.51	0.37	0.54	0.59	0.21	0.50	0.50	0.12	0.35	21.40[5]	0.12[5]	4.11[5]

[1]No reliable estimates are available. [2]Total catch used in the assessment. [3]Autumn survey kg/tow. [4]Ratio of catch to biomass index.
[5]Values for 1963-1999

Southern Stock Area (1955-1999)

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Max	Min	Mean
Landings	13.6	10.1	10.3	12.9	12.0	12.0	12.3	12.8	12.4	10.1	307.1	9.2	44.7
Discards[1]	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Catch[2]	13.6	10.1	10.3	12.9	12.0	12.0	12.3	12.8	12.4	10.1	307.1	9.2	44.7
Biomass Index[3]	1.65	0.91	0.98	1.33	0.80	1.64	0.43	0.84	0.62	0.87	3.91[5]	0.43[5]	1.81[5]
Exploitation Rate Index[4]	8.3	11.1	10.5	9.7	15.0	7.3	28.5	15.2	20.1	11.6	127.5[5]	3.7[5]	27.8[5]

[1]No reliable estimates are available. [2]Total catch used in the assessment. [3]Autumn survey kg/tow. [4]Ratio of catch to biomass index.
[5]Values for 1963-1999

Stock Distribution and Identification: Silver hake range from Newfoundland to South Carolina. Two subpopulations of silver hake are assumed to exist from Cape Hatteras to the Gulf of Maine. The northern silver hake inhabits the Gulf of Maine and northern Georges Bank while the southern silver hake inhabits southern Georges Bank, southern New England, and the Mid-Atlantic Bight. The northern and southern subpopulations mix on Georges Bank but the amount of mixing and movement between areas is unknown.

Catches: Silver hake landings are currently low in comparison to the long-term average. Discards of silver hake occur in directed small-mesh trawl fisheries and in non-directed large-mesh trawl, scallop dredge, shrimp trawl, and sink gill net fisheries but no reliable estimates of discards are currently available.

Data and Assessment: An age-structured sequential population analysis was conducted for the entire silver hake population from Cape Hatteras to the Gulf of Maine using NEFSC autumn and spring numbers-at-age indices and time-varying survey catchability. Another population analysis was conducted for the entire silver hake population using NEFSC autumn and spring biomass indices in a Bayesian surplus production model. In addition, analyses of research vessel survey indices were used to quantify biomass and exploitation rate.

Biological Reference Points: Silver hake are overfished when the 3-year moving average of the autumn survey weight per tow is less than 3.31 kg/tow in the northern stock and 0.78 in the southern stock. Overfishing occurs when fishing mortality derived from the latest three-years of survey data exceeds $F_{0.1}$ (0.41 in the north and 0.39 in the south).

Fishing Mortality: Current fishing mortality on silver hake is not known. However, indices of exploitation rate suggest that fishing mortality is lower now than during the distant water fishery in the 1960s and 1970s.

Recruitment: Indices of silver hake recruitment (age 1) from the NEFSC autumn and spring surveys vary substantially but do not appear to exhibit a long-term trend. The highest observed recruitment indices occurred in 1998 and suggest that the 1997 year class may be larger than average.

Stock Biomass: Survey indices of silver hake biomass in northern and southern areas show opposite trends through time. Biomass in the north has steadily increased since the early 1970s while biomass in the south has decreased. In the 1960s, roughly 50% of silver hake biomass, as indexed by the NEFSC autumn survey, was in the Gulf of Maine; this percentage has increased to 80% in the 1990s. In contrast, about 40% of silver hake biomass was in southern New England waters in the 1960s; this percentage has decreased to 10% in the 1990s.

Special Comments: Silver hake growth patterns and spatial distribution have changed through time. The age structure appears to be truncated at about age-6 in recent years based on survey data. However, limited sampling of commercial fishery catches and the possibility of lower availability of older fish to the NEFSC survey gear due to oceanographic and ecological changes in the northwest Atlantic ecosystem make it difficult to be certain that older fish are no longer present in the population.

Sources of Information: Almeida, F. 1987. Stock definition of silver hake in the New England-Middle Atlantic area. N. Amer. J. Fish. Mgt. 7:169:186. Helser, T. 1996. Growth of silver hake within the U.S. continental shelf ecosystem of the northwest Atlantic Ocean. J. Fish. Biol. 48:1059-1073. Brodziak et al. 2000. Assessment of the silver hake resource in the northwest Atlantic in 2000. NEFSC Ref. Doc. 01-03.

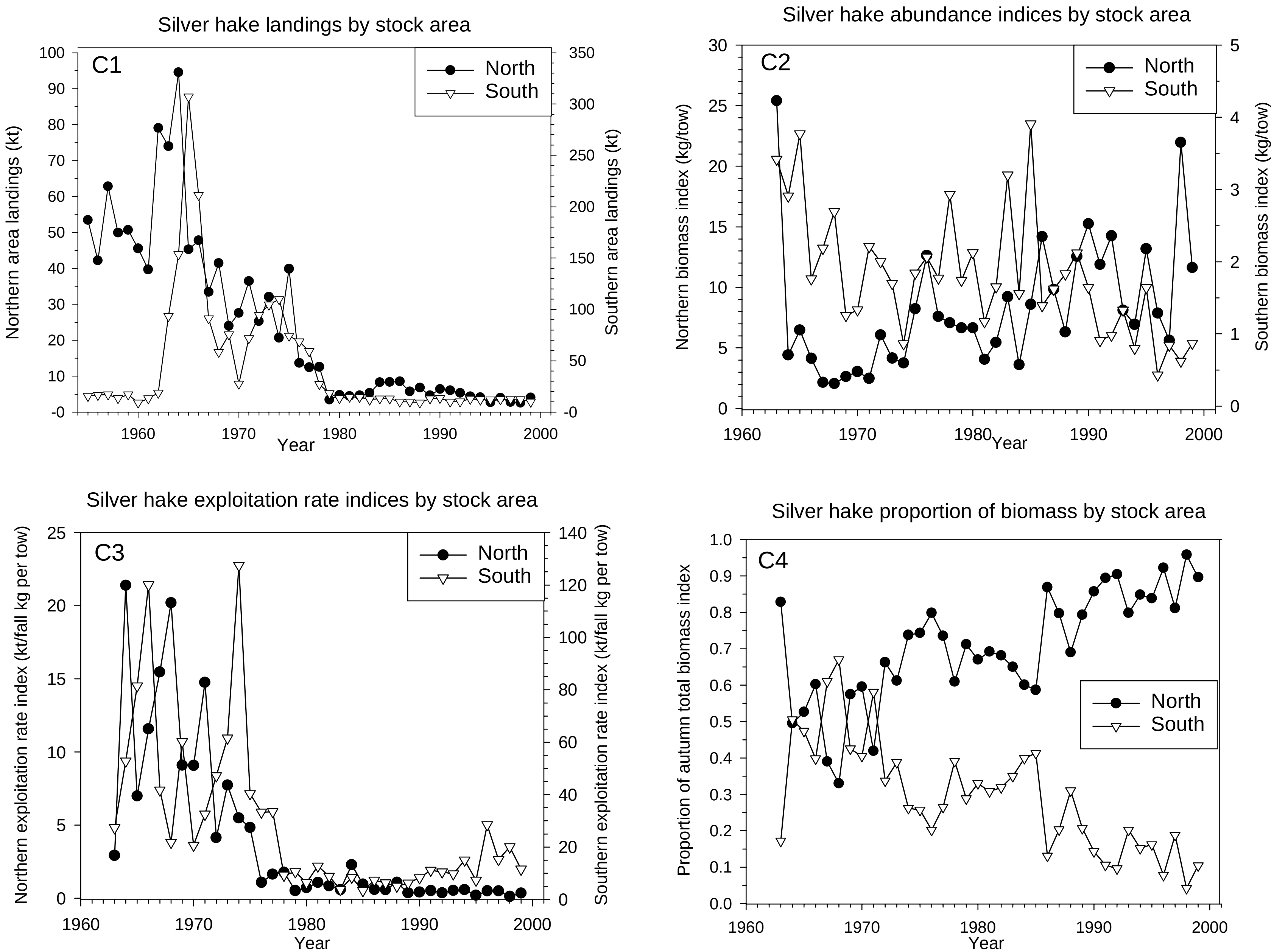
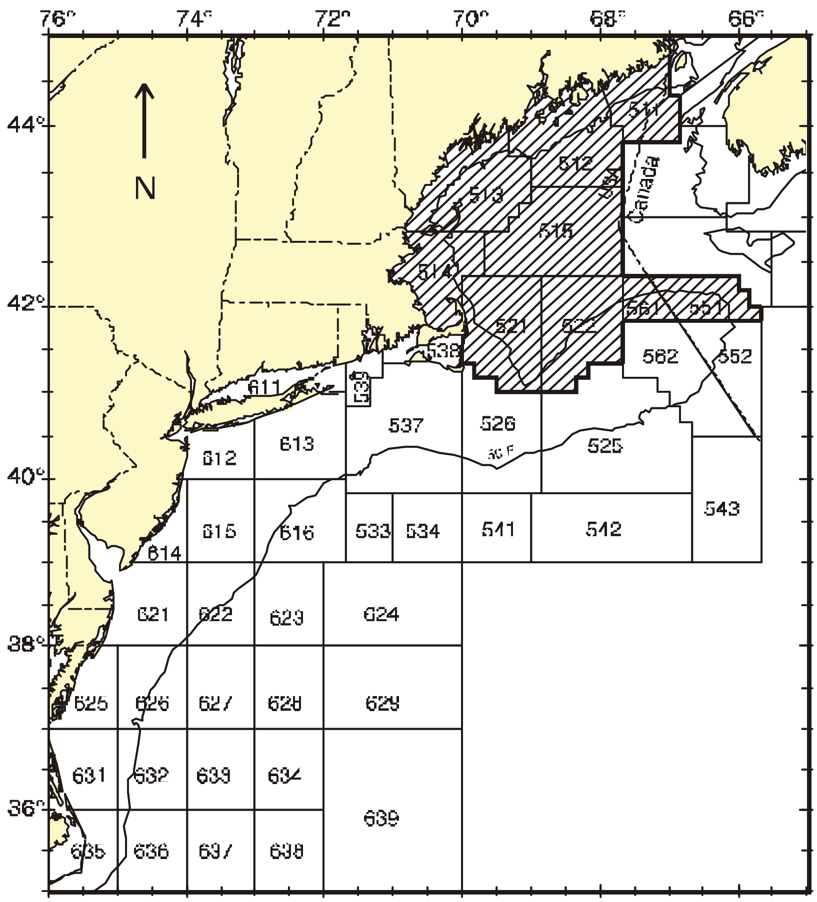

Silver hake landings by stock area
C1
North
South
Northern area landings (kt)
Southern area landings (kt)
Year
Silver hake abundance indices by stock area
C2
North
South
Northern biomass index (kg/tow)
Southern biomass index (kg/tow)
Year
Silver hake exploitation rate indices by stock area
C3
North
South
Northern exploitation rate index (kt/fall kg per tow)
Southern exploitation rate index (kt/fall kg per tow)
Year
Silver hake proportion of biomass by stock area
C4
North
South
Proportion of autumn total biomass index
Year

Figure C5. Commercial fishery statistical areas for northern (SA 511-515, 521, 522, 551, and 561) and southern (SA 525, 526, 533-539, 541-543, 552, 562, 611-639) silver hake in the northwest Altantic.



D. GULF OF MAINE HADDOCK ADVISORY REPORT

State of Stock: The Gulf of Maine haddock stock is overfished and overfishing is occurring relative to the Amendment 9 control rule. The current exploitation rate index (0.246, 1997-1999 avg) is below the F_{MSY} proxy but well above the current F_{TARGET} and $F_{THRESHOLD}$ implied by the harvest control rule. The current biomass estimate (3.41 kg/tow, 1997-1999 average) is below the $B_{THRESHOLD}$ (4.39 kg/tow). However, there are concerns about the robustness of reference points and the estimates of current exploitation rates and biomass.

Exploitation rates have declined in the 1990s and are currently among the lowest on record (Figure D1). Survey abundance and biomass indices have increased from record low levels in the early 1990s, and there is evidence of some broadening of the age structure of the stock. Recent recruitment has improved and research vessel surveys indicate strong 1998 year classes that can be expected to recruit to the fishery in 2001-2003. However, biomass and landings remain well below historic levels.

Management Advice: Application of the Amendment 9 harvest control rule implies that fishing mortality should be reduced to zero for this stock. Reductions in fishing mortality will promote further increases in stock biomass and further broadening of age structure needed to rebuild this stock. The core of Gulf of Maine haddock distribution is in the vicinity of the current Western Gulf of Maine closure area and continued closure will assist in protecting the stock.

Forecast for 2001: No forecasts were performed.

Catch and Status Table (weights in '000 mt): Gulf of Maine Haddock

Year	1992	1993	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]	Max[1]	Min[1]	Mean
US commercial landings	0.3	0.2	0.1	0.2	0.3	0.6	1.0	0.7	7.3	0.1	2.3[2]
Otter trawl	0.3	0.2	0.1	0.2	0.3	0.6	1.0	0.7	6.1	0.1	2.2[2]
Other gear	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.2	<0.1	0.1[2]
Canada commercial landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.4[3]
Other commercial landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	<0.1[4]
Total commercial landings	0.3	0.2	0.1	0.2	0.3	0.6	1.0	0.7	7.6	0.1	2.6[2]
Commercial Discards	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Catch used in assessment	0.3	0.2	0.1	0.2	0.3	0.6	1.0	0.7	7.6	0.1	2.6[2]
Autumn Survey Biomass	0.09	0.47	0.21	1.09	3.54	2.42	2.91	4.91	50.69	0.12	8.05[2]
Exploitation Index[5]	2.67	2.48	1.45	0.37	0.25	0.23	0.25	N/A	2.67	0.15	N/A

[1] U.S. landings and total data from 1994 to 1999 are provisional. [2] Over period 1963-1999. [3] Over period 1963-1986. [4] Over period 1963-1975.
[5] Exploitation index is the 3 year running average of landings (000's mt) / autumn survey biomass index) as defined in the SFA Harvest Control Rule.

Stock Distribution and Identification: Haddock resources within U.S. waters are assessed and managed as two separate stocks: Georges Bank and south and the Gulf of Maine. These stock definitions are based on tagging and movement studies, meristic data, age composition, and growth and recruitment data. In the Gulf of Maine, haddock are primarily distributed along the 50-fathom contour from Jeffrey's Ledge to Stellwagen Bank. During years of higher abundance and broader age structures, there is a continuous distribution of haddock from Jeffrey's Ledge into the Great South Channel, and older fish are distributed into the central Gulf of Maine.

Catches: Historically, Gulf of Maine haddock were exploited primarily by the United States and Canada, although there are several years where landings from other countries (Spain, USSR) were significant. Commercial landings averaged 5,600 mt from 1956 to 1967 before declining to less than 600 mt in 1973 (Figure D1). Landings increased in the mid-1970s and averaged 5,400 mt from 1977 to 1985. Landings declined during the mid 1980s falling below 900 mt in 1987 and reached a record low of 112 mt in 1994. During the late 1990s, landings increased again exceeding 1,000 mt in 1998. Discards were believed to be significant during 1994-1997 but can not be estimated.

Data and Assessment: Exploitation rates and biomasses were evaluated on the basis of research survey data and catches.

Biological Reference Points: The reference points used in the harvest control rule were estimated by a surplus production model and the U.S. Autumn survey index (Figure D4). The F_{MSY} threshold proxy = 0.29 (in exploitation index units: landings (000's mt)/NEFSC Autumn survey index). The F_{MSY} target proxy is defined as the 80% percentile of the F_{MSY} threshold proxy or 0.20 (in exploitation units). The B_{MSY} proxy = 8.25 (in NEFSC Autumn survey biomass units: stratified mean weight (kg) per tow).

Fishing Mortality: The exploitation index (catch (000s mt)/autumn survey biomass index) represents the primary source of information on rates of fishery removals (Figure D1). The exploitation rate increased in the mid to late 1960s and decreased in the early to mid 1970s. The exploitation index experienced two sharp peaks in the early 1980s and early 1990s before decreasing in the late 1990s.

Recruitment: Catch at age indices from the NEFSC spring and autumn research vessel surveys represent the primary source of information on recruitment (Figure D3). Both surveys indicate strong recruitment associated with the 1963 year class and a series of stronger year classes between 1972 and 1982. Both surveys indicate a series of weak year classes occurring between 1964 and 1971, and between 1983 and 1991. Surveys indicate improved recruitment beginning in 1992 and provide evidence of strong 1998 year classes.

Stock Biomass: Biomass indices from the NEFSC spring and autumn research vessel surveys represent the primary source of information of stock biomass (Figure D2). Both surveys exhibit high levels of biomass in the mid to late 1960s, a sharp decline in the early to mid 1970s, increasing stock biomass in the mid to late 1970s, and a decline to record low levels by the early 1990s. Both surveys indicate an apparent increase in stock biomass during the late 1990s.

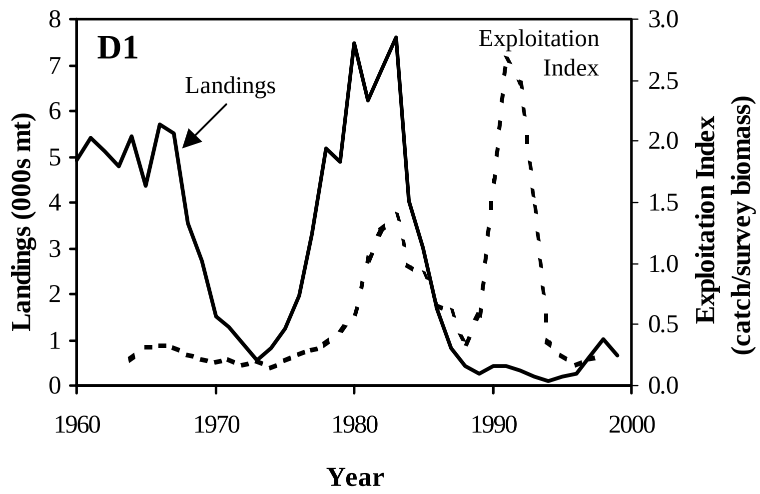
Special Comments: The fishing mortality rate index is sensitive to the age range from the survey. In addition, when stock abundance is low the fishing mortality rate index is less reliable. It would be desirable to develop more robust estimators of exploitation rate.

For this stock, the surplus production model used to establish the reference points is very sensitive to historical catches. Furthermore, the addition of a few additional years of data has a large effect on the estimates. The relative biomass reference point seems more robust than the FMSY proxy to this problem. As a result, the basis of the reference point models needs to be evaluated.

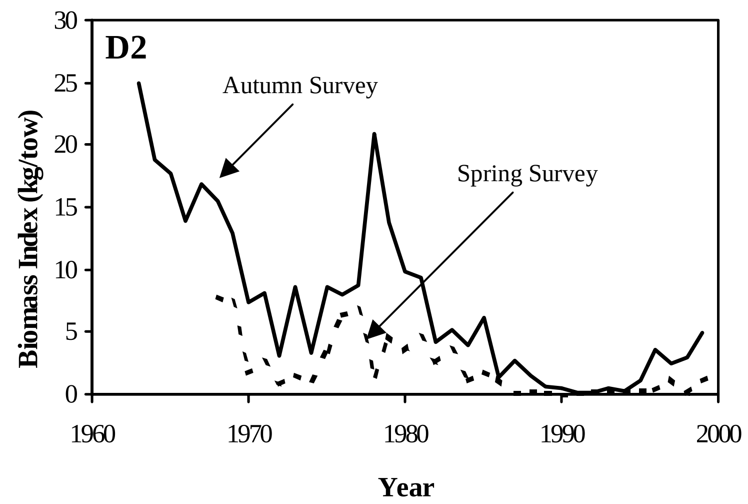
Sources of Information: Report of the 32nd Northeast Regional Stock Assessment Workshop (32nd SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 01-05; R. Brown. Assessment of the Gulf of Maine haddock stock, 1963-1999. NEFSC Ref. Doc. 01-xx (In Press).

Gulf of Maine Haddock

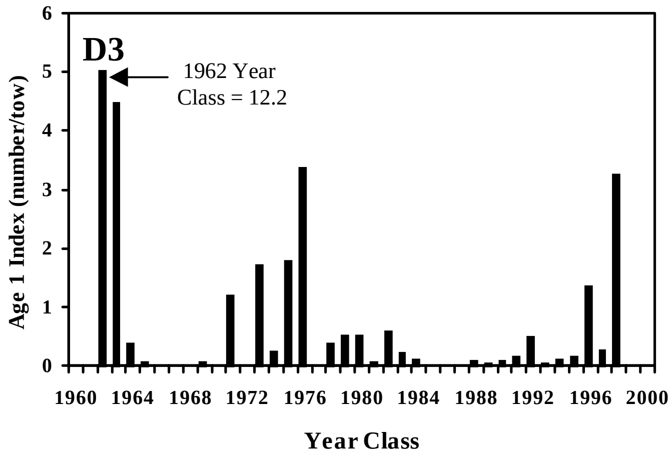
Trends in Commercial Landings and Fishing Mortality



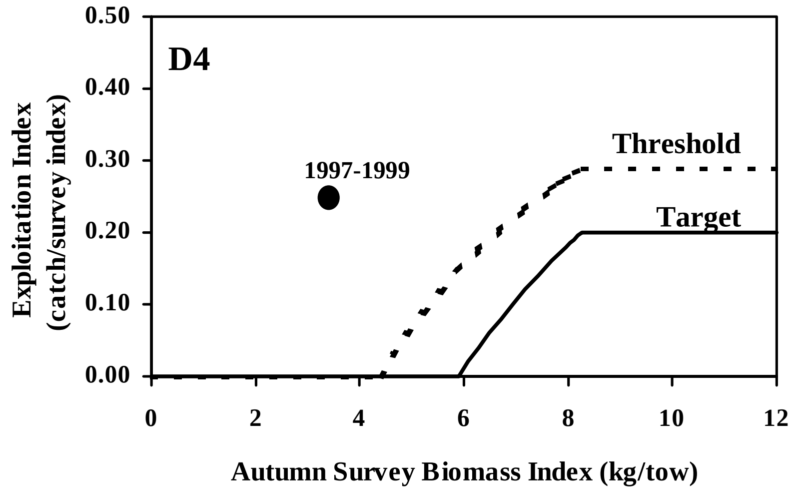
Trends in Stock Biomass



Trends in Recruitment



Harvest Control Rule



CONCLUSIONS OF THE SAW STEERING COMMITTEE MEETING

The Steering Committee for the Northeast Regional Stock Assessment Workshop (SAW) met in Providence RI on 13-14 February, 2001. Discussed were assessments to be reviewed at the 33rd SARC (June, 2001), potential assessments to be reviewed by the 34th SARC (November, 2001) and subsequent SARCs, and revisions to the overall SAW process.

Participating were: Jack Dunnigan of the ASMFC; Paul Howard, Tom Hill, and Chris Kellogg of the NEFMC; Chris Moore and Jim Guilford of the MAFMC; Patricia Kurkul and George Darcy of the Northeast Regional Office; Steve Clark, Fred Serchuk, Mike Sissenwine, Terry Smith (SAW Chairman), Frank Almeida, and Pie Smith (SAW Coordinator), NEFSC.

SAW 32

The 32nd Stock Assessment Workshop cycle is complete. The Stock Assessment Review Committee (SARC) reviewed assessments for scallops, silver hake, American plaice, and Gulf of Maine haddock in December, 2000. Draft documents (32nd Northeast SAW Public Advisory Report; the 32nd Northeast SAW SARC Consensus Summary of Assessments) have been produced and distributed to the Council/Commission. Chairman of the SARC was Dr. Robin Cook, of Aberdeen Marine Laboratory, representing the Center for Independent Experts (CIE).

Two Public Review Workshops were held: one at a NEFMC meeting on January 25th in Danvers, MA and one at the MAFMC meeting on February 7th in Wilmington, DE.

SAW 33 (SARC June, 2001)

The SARC will meet the week of 23-29 June, 2001 in Woods Hole, MA and will review assessments of Gulf of Maine cod, white hake and redfish. Reports will be provided to the New England and Mid-Atlantic Councils in July 2001 and Public Review Workshops will occur in July-August, at regularly scheduled meetings of the two councils.

SAW 34 (SARC, November-December, 2001)

The 34th SARC will meet in Woods Hole in mid-November to early December. Meeting dates will be finalized shortly. Stock assessments scheduled for review are monkfish, short-finned squid (illex) and, possibly pollock, depending on the status of a joint USA-Canadian assessment.

SAW 35 (SARC, June, 2002)

A preliminary list of stocks to be assessed and reviewed includes Gulf of Maine winter flounder, Georges Bank winter flounder, summer flounder, and, possibly Southern New England/Mid-Atlantic yellowtail flounder.

In terms of longer term planning the SAW Steering Committee is considering the following tentative schedule: SAW 36 (SARC, December 2002) - tilefish, red crab, silver hake, possibly surclam (if a clam survey takes place); SAW 37 (SARC, June 2003) - scup, black sea bass, ocean quahog (again dependent on a clam survey in 2002).

Other Business

The Steering Committee discussed a number of other issues including assessment updates, the ASMFC assessment process, a joint ASMFC/SAW/TRAC publication series, generic terms of reference, revisions to the SAW model, the role of industry advisors on the SARC, and more general coordination issues with respect to the SAW, the TRAC and assessment updates. (Detailed meeting minutes are available upon request. Contact Pie Smith, SAW Coordinator, pie.smith@noaa.gov.)

The Steering Committee agreed to continue to meet under the umbrella of the Regional Coordinating Council, specifically at a scheduled October 2001 meeting.

ELIMINATE, REPLACE WITH CURRENT "SAW/SARC ASSESSMENT REVIEW BY SPECIES" (Excel spreadsheet)

he Table 1. Northeast Stocks, Assessment Classification and Status

STOCK	Assessment Type	Last Assessed	Assessment Frequency	Next Assessment
BLUEFISH	Analytical	1996	3	2000
FLDR, SUMMER	Analytical	1999	2	2000
LOBSTER	Analytical	1996	3	2000
COD, Georges Bank	Analytical	1999	2	2000
COD, Gulf of Maine	Analytical	1999	2	2001
FLDR, WINTER, GB	Analytical	1999	2	2000
FLDR, Yellowtail, GB	Analytical	1999	2	2000
FLDR, Yellowtail, SNE	Analytical	1999	2	2001
HADDOCK-Georges Bank	Analytical	1999	2	2000
HERRING	Analytical	1998	3	2001
SHRIMP, NORTHERN	Analytical	1997	5	2002
STRIPED BASS	Analytical	1997	5	2002
FLDR, AM. PLAICE	Analytical	1998	3	2001
FLDR, WINTER, SNE	Analytical	1998	3	2001
FLDR, Yellowtail, CC	Analytical	1998	3	2001
OCEAN QUAHOG	Analytical	1998	3	2000
SCALLOPS	Analytical	1999	2	2001
WHITE HAKE	Analytical	1998	3	2001
FLDR, WITCH	Analytical	1999	3	2002
POLLOCK	Analytical	1997	5	2000
SPINY DOGFISH	Analytical	1999	5	2004
SQUID, ILLEX	Analytical	1999	5	2004
SQUID, LOLIGO	Analytical	1999	5	2004
SURFCLAM	Analytical	2000	3	2003
MACKEREL, ATLANTIC	Analytical	2000	3	2003
WEAKFISH	Analytical	2000	5	2005
CUSK	Index	1995	5	2000
SCUP	Index	1998	5	2004
TILEFISH	Index	1999	5	2004
WOLFFISH	Index	1995	5	2000
BLACK SEA BASS	Index	1998	5	2003
RIV. HERRING/SHAD	Index	1988	5	TBD
BUTTERFISH	Index	1993	5	1998
FLDR, Windowpane, GB	Index	1997	5	2002
FLDR, Windowpane, Mid-Atlantic	Index	1997	5	2002
FLDR, WINTER, GOM	Index	1995	5	2000
GOOSEFISH	Index	1996	5	2001
HADDOCK-Gulf of Maine	Index	1995	5	2000
OCEAN POUT	Index	1990	5	TBD
RED HAKE, Northern	Index	1990	5	2000
RED HAKE, Southern	Index	1990	5	2000
REDFISH	Index	1992	5	TBD
SILVER HAKE, Northern	Index	1995	5	2000
SILVER HAKE, Southern	Index	1995	5	2000
SKATES	Index	1995	5	2005
TAUTOG	Index	1995	5	2005