Northeast Fisheries Science Center Reference Document 99-13

29th Northeast Regional Stock Assessment Workshop (29th SAW)

Public Review Workshop

September 1999

Northeast Fisheries Science Center Reference Document 99-13

A Report of the 29th Northeast Regional Stock Assessment Workshop

29th Northeast Regional Stock Assessment Workshop (29th SAW)

Public Review Workshop

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

September 1999

The *Northeast Fisheries Science Center Reference Document* series is an informal report series designed to assure the long-term documentation and to enable the timely transmission of research results emanating from various Center laboratories. The reports are reviewed internally before publication, but are not considered formal literature. The National Marine Fisheries Service does not endorse any proprietary material, process, or product mentioned in these reports. To obtain additional copies of this report, contact: Research Communications Unit, Northeast Fisheries Science Center, Woods Hole, MA 02543-1026 (508-495-2260).

This report may be cited as: Northeast Fisheries Science Center. 1999. Report of the 29th Northeast Regional Stock Assessment Workshop (29th SAW): Public Review Workshop. *Northeast Fish. Sci. Cent. Ref. Doc.* 99-13; 37 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026.

TABLE OF CONTENTS

Introduction

The Public Review Workshop of the 29th Northeast Regional Stock Assessment Workshop (SAW 29) was held in two sessions in conjunction with scheduled meetings of the New England and Mid-Atlantic Fishery Management Councils (NEFMC and MAFMC). Both sessions were on August 10, 1999; the NEFMC presentation took place in Hyannis, MA and the MAFMC Public Review Session in Philadelphia, PA.

The purposes of the workshop were to present assessment results and management advice for witch flounder (grey sole), sea scallops, loligo (long-finned) squid and illex (short-finned) squid. Assessments for the four stocks had been peer reviewed by the 29th Stock Assessment Review Committee (SARC) at a June 21 - 25, 1999 meeting in Woods Hole, MA. Copies of the SAW 29 *Draft Advisory Report on Stock Status* and the SAW 29 *Consensus Summary of Assessments* had been distributed to Council members prior to the Workshops. The Advisory Report provides a summary of the assessments reviewed and includes sections on stock status, management advice and short-term forecasts. The advisory report also includes reference information on recent catches, fishing mortality, stock size, and recruitment as well as information on the methodologies used to assess the stock. The final *Advisory Report on Stock Status* follows this introduction.

A more detailed report on each stock assessment's background, methodology, and results is contained in the *SAW 29 Consensus Summary of Assessments.* The final version of that document is published separately and available from the Northeast Fisheries Science Center as *Center Reference Document 99-14*.

The presentation to the New England Council was led by Dr. Michael Sissenwine, Science and Research Director for the Northeast Fisheries Science Center in Woods Hole, with the assistance of Drs. Paul Rago and Jeff Cross. The NEFMC presentation focused on the sea scallop assessment and on related recent experimental fisheries work in areas closed to scallop fishing.

The presentation to the Mid-Atlantic Council was given by Dr. Terry Smith, SAW Chairman, with the assistance of Dr. Steve Cadrin, and focused on the loligo and illex squid assessments. Each of the presentations was followed by a question-and-answer session.

Status Summaries

<u>Witch Flounder</u>

The witch flounder (grey sole) stock is near target biomass and fishing mortality levels. The estimated age 3+ biomass in 1999 is near the B_{MSY} target level. Recruitment has been above average since 1992. Relative to the Fishery Management Plan's (FMP) control rule and projected 1999 status, a fully-recruited F target in the year 2000 is 0.19. Fishing at this target rate is expected to allow biomass to increase above B_{MSY} and initiate rebuilding of the stock's age structure.

<u>Sea Scallops</u>

The U.S. Georges Bank portion of the sea scallop stock is not overfished but its biomass is below the B_{MSY} target level. The Mid-Atlantic portion of the stock is at or near the ¼ B_{MSY} biomass threshold used to indicate that the stock is overfished. Biomass levels for both stocks have increased primarily due to growth of scallops in areas that were closed to fishing to protect groundfish. Recruitment of scallops fluctuated around average values during 1995-1998. The Georges Bank stock is being exploited at or near the F_{MSY} overfishing threshold. Fishing mortality rates on the Mid-Atlantic portion of the stock exceed F_{MSY} and overfishing is occurring.

For the Georges Bank portion of the stock, fishing mortality should remain below F_{MSY}. Fishing mortality should be reduced below F_{MSY} in the Mid-Atlantic region. Further rebuilding can be expected if fishing mortality remains low. Because growth overfishing is occurring in open areas of both regions, effort reductions in open areas should result in increased yields. Area closures have resulted in progress towards rebuilding the stocks and reducing overfishing. In 1998 the percentage of total scallop biomass in closed areas was 90% for the U.S. Georges Bank region, 50% for the Mid-Atlantic region, and 80% for the areas combined. If closed area management harvest policies are adopted, definitions of overfishing and management procedures need to be re-examined.

Inshore Longfin Squid (Loligo)

The stock is approaching an overfished state and overfishing is occurring. Current biomass is less than B_{MSY} and near the biomass threshold of ½ B_{MSY}. There is a high probability that fishing mortality exceeded F_{MSY} in 1998. Additional length-based analyses indicated that fully-recruited fishing mortality is greater than F_{max} and that stock biomass is among the lowest in the assessment time series. Recent survey indices of recruitment are below average.

Fishing mortality should be reduced to end overfishing and to rebuild stock biomass to B_{MSY}. According to the current FMP, F should be reduced to as close to zero as practicable should the stock size decrease below the ½ B_{MSY} threshold. Projections show that continued fishing at current F will drive the stock below its biomass threshold in 2001, but rapid rebuilding to B_{MSY} can be achieved fishing at a rate of 75% F_{MSY}. Total catch should not be concentrated in any one season as information on reproductive dynamics suggests complex interactions among seasonal cohorts.

Northern Shortfin Squid (Illex)

Overfishing is not likely occurring but the stock status with respect to an overfished state is unknown. Relative fishing mortality has shown a generally increasing trend. A provisional upper bound on fishing mortality, however, is below various proxies for F_{MSY}. Survey indices suggest that the stock has been in a low productivity regime since 1982.

Current management reference points may not ensure adequate spawning escapement for the stock as a whole. The selection of an F_{MSY} proxy and target F should be precautionary due to the annual life span and uncertainties about the life history and absolute stock size. Adequate spawner escapement from all fishery areas is required to ensure sufficient recruitment during the subsequent year, therefore, % MSP reference points would seem appropriate. In the interim, status quo fishing mortality rates should be maintained.

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, in this report, 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 RATE	$F_{THRESHOLD}$	$F_{THRESH} = 0$ or F min (The minimal achievable mortality rate.)	$F_{THRESH} < F_{MSY}$ (The maximum mortality rate that defines overfishing at various levels of biomass.)	$F_{THRESH} = F_{MSY}$
	F_{TARGET}	$F_{TARG} = 0$ or F min (The minimal achievable mortality rate.)	$F_{TARG} < F_{THRESH}$ (Where F_{TARGET} is chosen to minimize the risk of exceeding $F_{THRESHOLD}$)	$F_{TARG} < F_{MSY}$

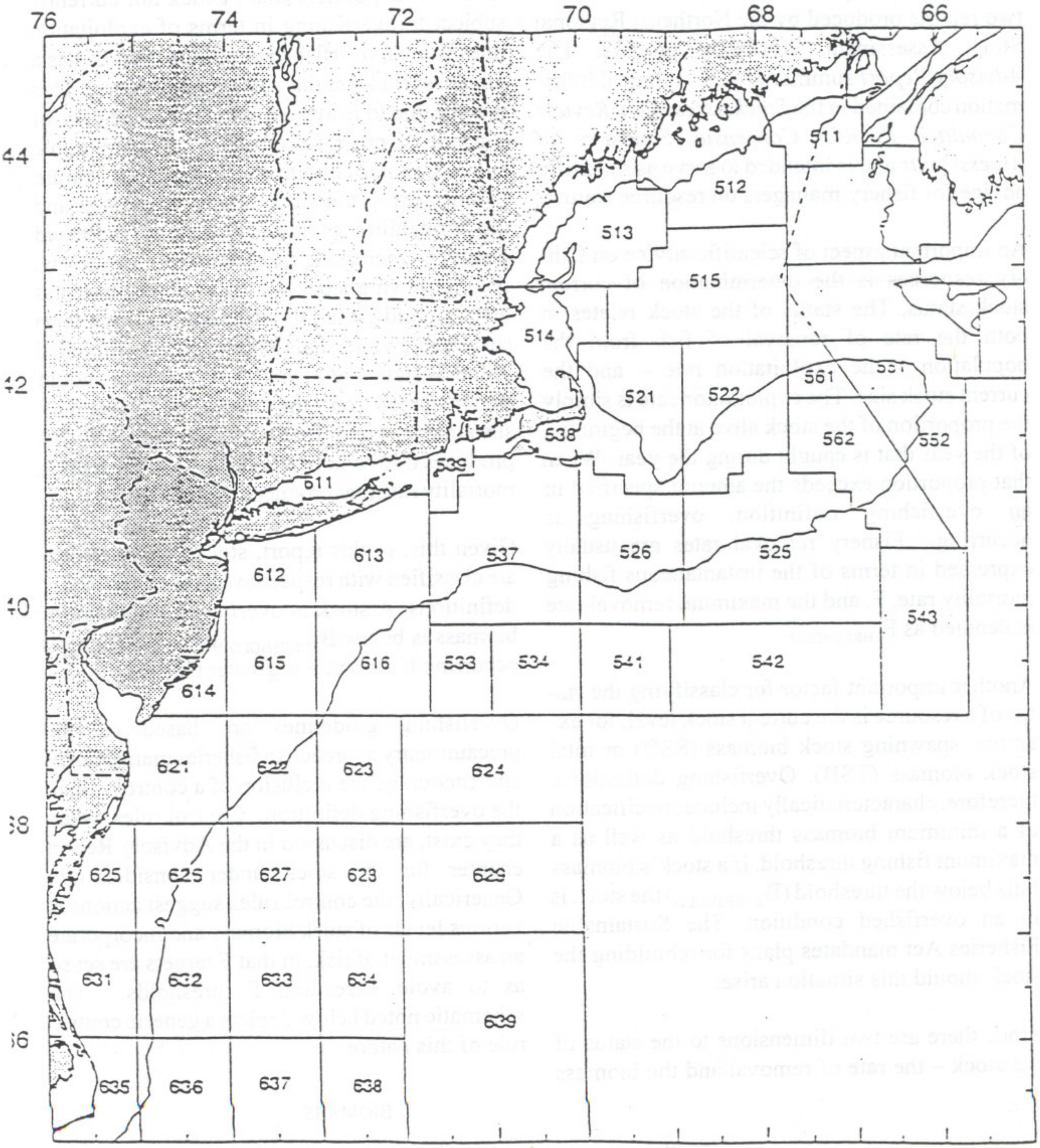


Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

GLOSSARY OF TERMS

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

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.

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}.

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 is also sometimes used 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 is highly undesirable.

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

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

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

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

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

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

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

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

$F_{10\%}$: The fishing mortality rate which reduces the spawning stock biomass per recruit (**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 which 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.

MSFCMA (Magnuson-Stevens Fishery Conservation and Management Act). U.S. Public Law 94-265, as amended through October 11, 1996. Available as NOAA

Technical Memorandum NMFS-F/SPO-23, 1996.

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

Minimum Stock Size Threshold (MSST, $B_{threshold}$). Another of the Status Determination Criteria. The greater of (a) $\frac{1}{2}B_{MSY}$, or (b) the minimum stock size at which rebuilding to B_{MSY} will occur within 10 years of fishing at the MFMT. MSST should be measured in terms of spawning biomass or other appropriate measures of productive capacity. If current stock size is below $B_{threshold}$, the stock is overfished.

Maximum Spawning Potential (MSP) 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.

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 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.

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 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 assumed to be constant.

A. WITCH FLOUNDER ADVISORY REPORT

State of stock: The witch flounder (grey sole) stock is near target biomass and fishing mortality levels (Figure A7). The estimated total age 3+ biomass in 1999 is 26,050 mt (above the overfished threshold and near B_{MSY}). The fishing mortality rate declined by 57% between 1996 and 1998 to 0.37 (29% exploitation; Figure A1) and is projected to decline to 0.20 (17% exploitation, slightly lower than the overfishing threshold) in 1999 based on part-year catch statistics. Recruitment has been above average since 1992 (Figure A2). Total age 3+ biomass declined steadily from 27,930 mt in 1982 to 7,700 mt in 1994, then sharply increased to 18,900 mt in 1998. Spawning stock biomass (SSB) has doubled from a record-low level of 4,200 mt in 1995 to 8,700 mt in 1998 (Figure A2) but is still below historically high levels (Figure A8). Since the mid-1980s, the age structure remains severely truncated (Figure A9). The low numbers of older fish may adversely impact reproductive output.

Management Advice: Fishing mortality should not be allowed to increase above the target. Application of the FMP's control rule to the projected 1999 status (Figure A7) implies a fully recruited F target of 0.19 (16% exploitation) in the year 2000. Continued fishing at this rate will allow for continued rebuilding of the age structure. Fishing at a rate above this target will dissipate the potential benefits that the recent recruitment levels would otherwise produce.

Forecast for 2000-2001: Fishing at the status quo F (0.20) or at the target F (0.19) in 2000-2001 is expected to allow biomass to increase above B_{MSY} and initiate rebuilding of the age structure.

Forecast Table: Assuming 1999 catches = 1998 catches, $F_{99} = 0.20$; SSB and total biomass (3+) estimated to be 8,652 mt and 18,934 mt, respectively, in 1998. Initial (1999) stock sizes for ages 5-11 are from calibrated VPA; stock sizes for ages 3 and 4 were estimated from regression using survey data and calibrated VPA estimates for preceding years. Average 1995-1997 partial recruitment, average 1982-1998 mean weights at age, and 1994-1998 maturation ogive were used in projections. Weights reported in thousands of mt.

1999				2000			2001		Consequences/Implications
Catches	SSB	MidYear Biomass (3+)	F 2000-2001	Catches	SSB	Mid-Year Biomass (3+)	SSB	Mid-Year Biomass (3+)	
2.2	14.7	25.6	**F sq 0.20**	3.0	18.9	29.7	23.4	31.9	Catches increase; Biomass (3+) increases above B_{MSY}.
			F 10th%tile 0.19	2.9	19.0	29.8	23.6	32.2	Catches increase; Biomass (3+) increases above B_{MSY}.

Catch and Status Table (weights in '000 mt, recruitment in millions): Witch flounder

Year	1991	1992	1993	1994	1995	1996	1997	1998	Max	Min	Mean
USA Commercial Landings	1.80	2.25	2.60	2.67	2.21	2.09	1.78	1.85	6.34	1.40	3.60
Total Discards	0.09	0.17	0.38	0.42	0.27	0.45	0.39	0.33	0.45	0.02	0.20
Shrimp Fishery	0.03	0.02	>.01	0.02	0.03	0.01	0.01	0.01	0.03	>.01	0.02
Large Mesh Otter Trawl	0.06	0.15	0.37	0.40	0.23	0.44	0.38	0.32	0.44	0.01	0.20
Catch used in Assessment	1.89	2.42	2.98	3.09	2.48	2.54	2.17	2.18	6.43	1.50	3.70
Mean biomass (3+)	8.77	9.96	9.07	7.74	8.47	10.04	13.28	18.93	27.93	7.74	13.0
Spawning stock biomass[1]	5.49	5.32	4.38	4.61	4.18	4.48	5.61	8.65	18.12	4.18	8.51
Recruitment (Age 3)	8.95	15.28	10.91	13.87	27.83	26.14	20.55	22.69	27.83	2.95	13.72
Mean F (Ages 7-9,u)	0.28	0.27	0.58	0.65	0.69	0.86	0.67	0.37	0.86	0.21	0.49
Exploitation Rate	23%	22%	41%	45%	47%	54%	46%	29%	54%	18%	36%
F on 3+ biomass	0.22	0.24	0.33	0.40	0.29	0.25	0.16	0.13	0.40	0.13	0.28
Exploitation Rate	18%	20%	26%	31%	24%	21%	14%	13%	31%	13%	22%

[1] At beginning of spawning season, March 1.

Stock Identification and Distribution: A single stock of witch flounder is considered to inhabit the area from the northern Gulf of Maine to southwestern Georges Bank. The stock may extend to the south and into deeper slope waters. Distribution in Gulf of Maine is contiguous with Scotian Shelf; however, for this assessment, only witch flounder in U.S. waters were included.

Catches: U.S. landings increased during the 1960s from 1,200 mt to about 3,000 mt, then fluctuated between 2,000 and 3,000 mt until 1984 and 1985 when landings abruptly increased to about 6,000 mt. Landings have since declined to 1,849 mt in 1998 (Figure A1). Discards have varied from 25 mt in 1986 to over 400 mt in 1996. Over the 1982-1998 period, estimated discards have represented between 0.5% and 18.0% of the total U.S. commercial catch. Recreational catches are negligible.

Data and Assessment: An analytical assessment (calibrated VPA) of U.S. commercial catch (landings plus discards from the shrimp and large mesh otter trawl fisheries) at age data was conducted. Information on recruitment and abundance was taken from standardized NEFSC spring and autumn survey catch-per-tow at age data. Initially, recruitment estimates for the last two years in the series were unreasonably high and extremely sensitive to the assumed or estimated value for partial recruitment at young ages. For this reason, the stock sizes for ages 3 and 4 at the start of 1999 were estimated using regression between historical VPA estimates and survey values (the RCT approach of ICES). An exploratory Stock Synthesis analysis — which makes different assumptions than the VPA — was conducted and generally confirmed VPA results, except the notion that recent recruitment levels are 4-fold higher than average.

Biological Reference Points: Yield and SSB per recruit analyses updated with an assumed M = 0.15 indicate that $F_{0.1}$ = 0.16 (14% exploitation), F_{MAX} = 0.35 (28% exploitation), and $F_{20\%}$ = 0.37 (29% exploitation) (Figure A3).

SFA Control Rule: The FMP (Amendment 9) control rule states that when the stock biomass exceeds B_{MSY}, the overfishing threshold is F_{MSY}, and target F is the 10^{th} percentile of the estimated F_{MSY} distribution. When stock biomass is less than B_{MSY}, the overfishing threshold is based on maximum F that would allow rebuilding to B_{MSY} in five years. When biomass is less than the biomass threshold, the target F = 0. The biomass threshold is defined by the minimum stock size that is projected to rebuild to B_{MSY} in 5 years at F=0.

The Amendment 9 control rule was updated (Figure A7) with the revised estimates of F_{MSY} (0.106, biomass-weighted for ages 3+), B_{MSY} (25,000 mt) and the tenth percentile of F_{MSY} (0.09). MSY is estimated as 2,684 mt. Based on the ADAPT estimates of age 3+ mean biomass in 1998 (18,934 mt) and 1998 F on age 3+ biomass (0.13), overfishing was occurring in 1998. However, overfishing is not expected to occur in 1999 based on catch statistics to-date (Figure A7). Because 3+ biomass is expected to be slightly above B_{MSY} in 1999, the year 2000 target fishing mortality prescribed by the control rule is 0.09; the 10^{th} percentile of F_{MSY}. In terms of age 3+ biomass, the stock has been rebuilding faster than would be expected from the growth rates implicit in the Amendment 9 control rule. This higher-than-expected rebuilding rate is due to higher-than-expected year classes for 1992-1996.

Fishing Mortality: Fishing mortality (ages 7-9, unweighted) increased from 0.21 (18% exploitation) in 1982 to 0.59 (42% exploitation) in 1985, declined to 0.24 (20% exploitation) in 1990, increased to 0.86 (54% exploitation) in 1996, then dropped to 0.37 (29% exploitation) in 1998 (Figure A1). This trend in F is generally confirmed by the trend of pooled survey Z. There is an estimated 80% probability that the 1998 F lies between 0.28 and 0.51 (Figure A5). Almost all of the fishing mortality on age 1 and 2 witch flounder is generated by discarding practices in the northern shrimp fishery. At age 3, 77% of fishing mortality is generated by shrimp fishery discards; 23% is generated by discards in the large-mesh otter trawl fishery. At age 4, less than 5% of the F is generated by shrimp fishery discards, 85% of fishing mortality is generated by discards in the large-mesh otter trawl fishery and 11% of the mortality is generated by landings. By age 5, 65% of the F is generated by large-mesh discards and 38% of the F is generated by landings. At ages 6 and older, almost all of the F is generated by the landings component.

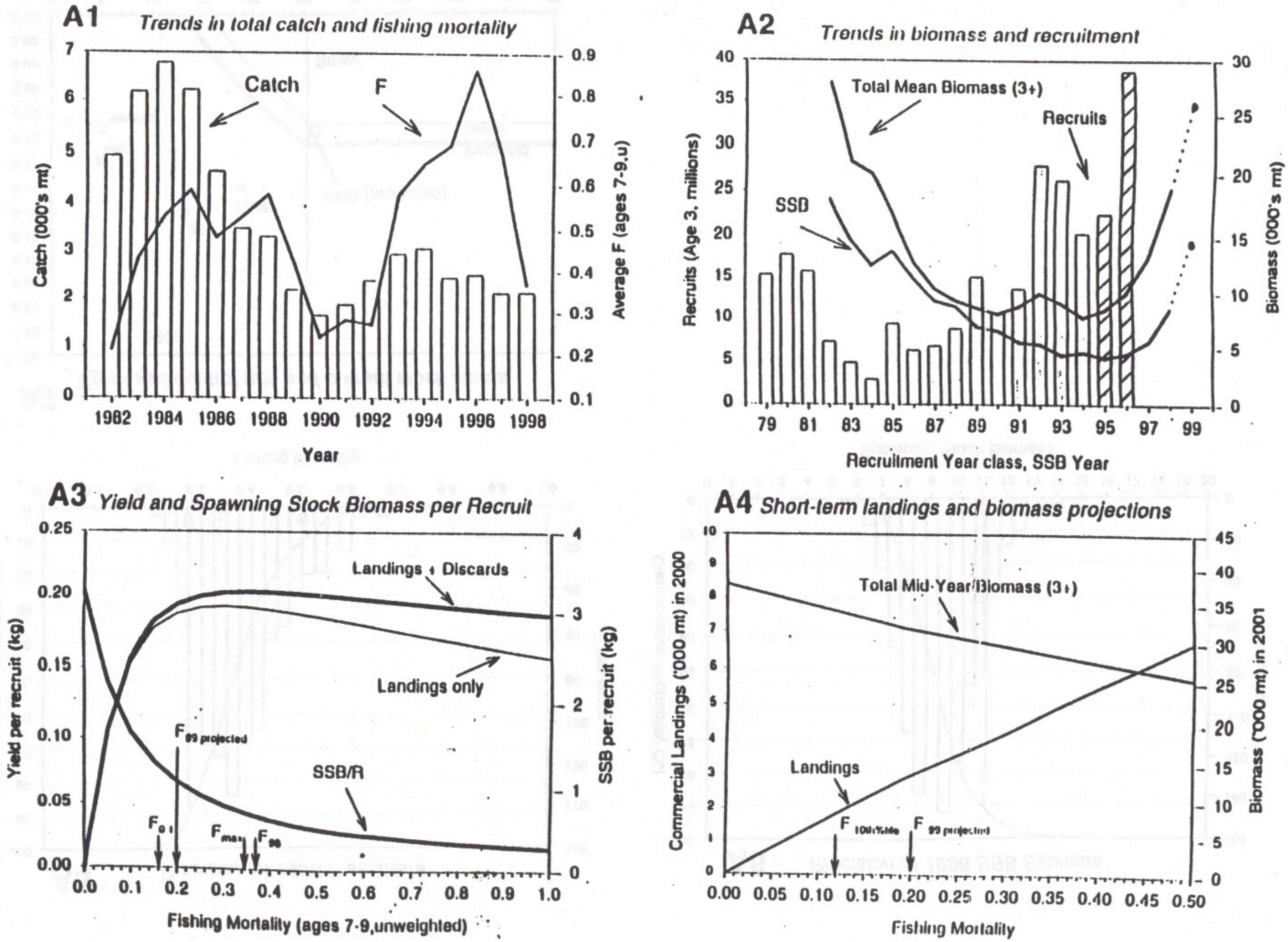
Recruitment: Geometric mean recruitment (age 3 fish) for the VPA time series is 12 million fish. The 1989 and 1991-1996 year classes appear to be above average (Figure A2), with the 1995 and 1996 year classes among the highest in the VPA estimates.

Spawning Stock Biomass: Average spawning stock biomass (SSB) for the VPA time series is 8,506 mt. SSB declined from 18,000 mt in 1982 to about 4,000 mt in 1995. Following recruitment and maturation of the 1991-1993 year classes, SSB increased to 8,652 mt in 1998 (Figure A2), but is still at a low level relative to the long-term survey data (Figure A8). There is an 80% probability that the 1998 SSB lies between 7,400 mt and 11,000 mt (Figure A6).

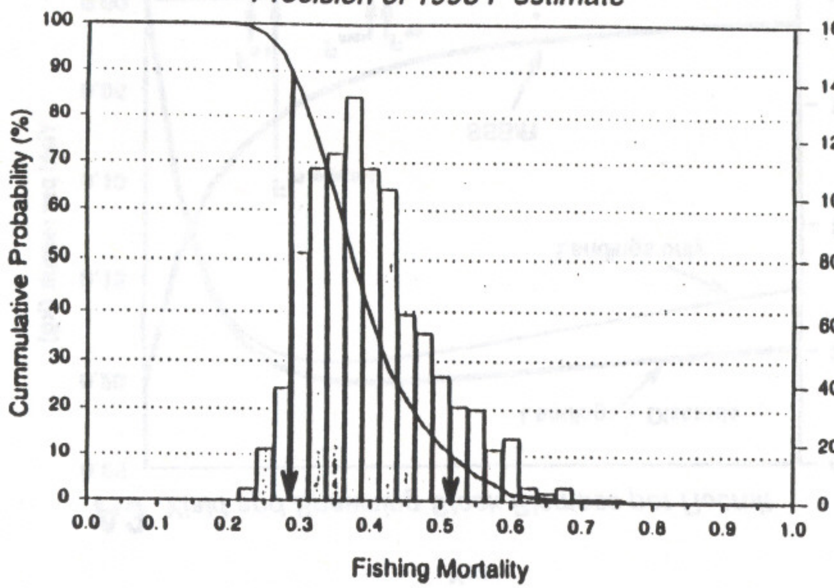
Special Comments: Maturity analyses have changed the estimation of SSB compared to the last assessment.

Source of Information: Report of the 29th Stock Assessment Workshop/Stock Assessment Review Committee, NEFSC CRD 99-14 and Assessment of the witch flounder stock in Subareas 5 and 6 for 1999, S.E. Wigley, NEFSC CRD (in press).

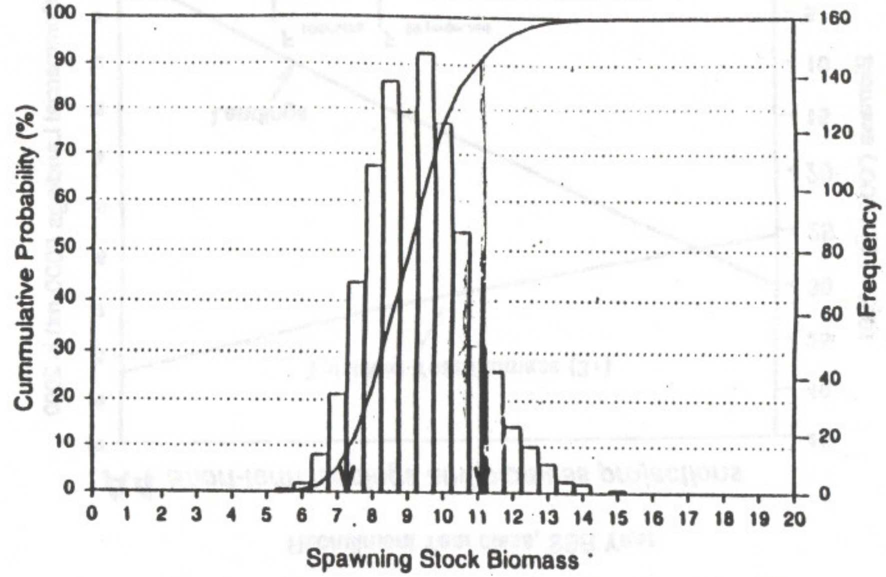
Witch flounder



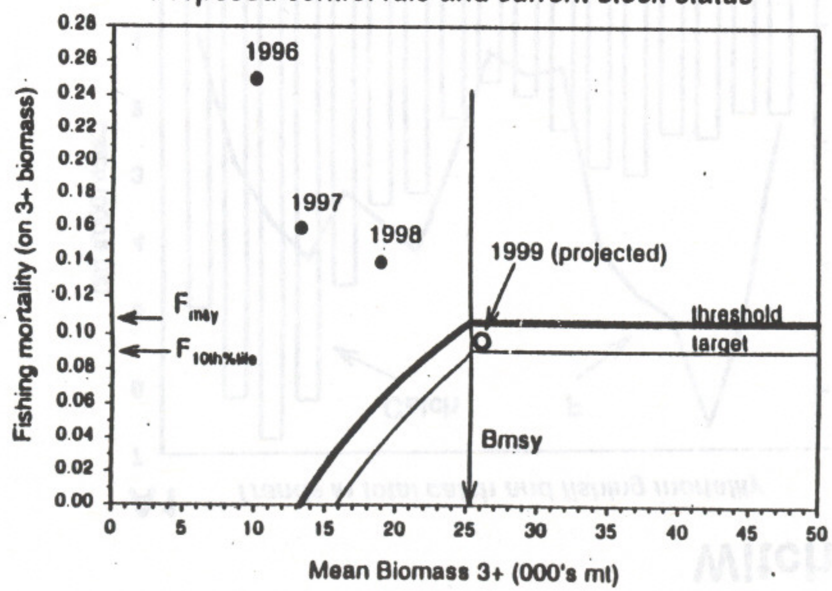
A5 *Precision of 1998 F estimate*

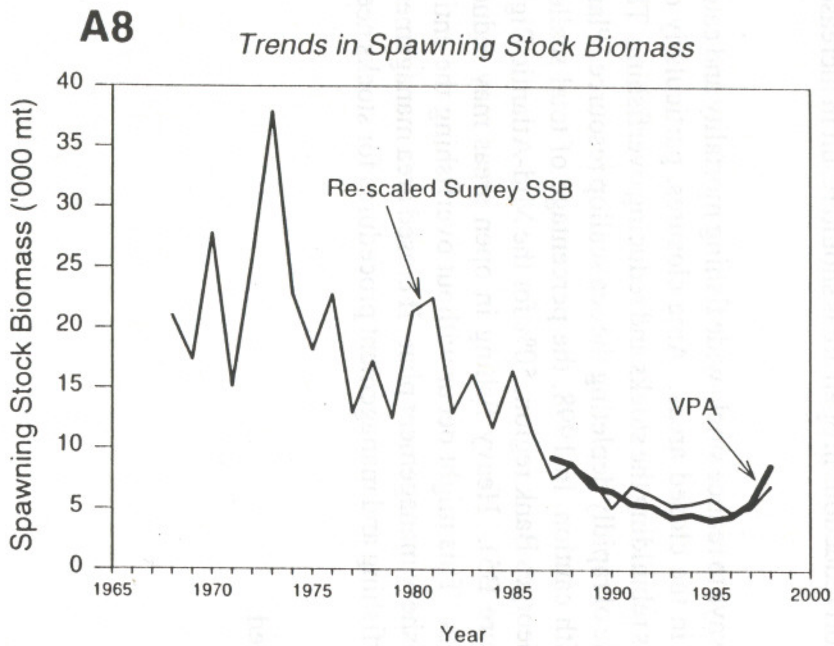


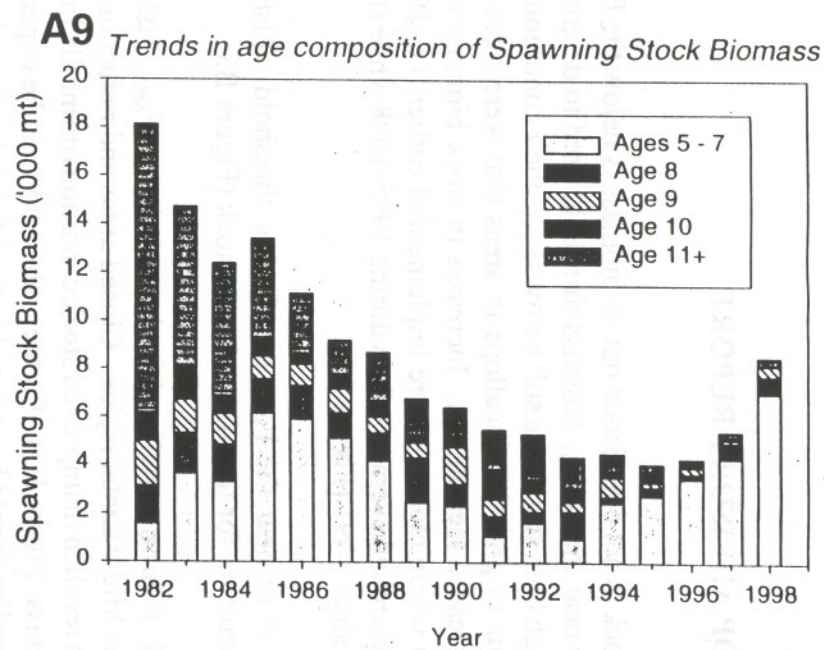
A6 *Precision of 1998 SSB Estimate*



A7 *Proposed control rule and current stock status*




A8
Trends in Spawning Stock Biomass
Spawning Stock Biomass ('000 mt)
40
35
30
25
20
15
10
5
0
Re-scaled Survey SSB
VPA
1965
1970
1975
1980
1985
1990
1995
2000
Year


A9
Trends in age composition of Spawning Stock Biomass
Spawning Stock Biomass ('000 mt)
20
18
16
14
12
10
8
6
4
2
0
Ages 5 - 7
Age 8
Age 9
Age 10
Age 11+
1982
1984
1986
1988
1990
1992
1994
1996
1998
Year

B. SEA SCALLOP ADVISORY REPORT

State of Stocks: The U.S. Georges Bank stock is not overfished but its biomass is below the B_{MSY} target level. The Mid-Atlantic stock is at or near the ¼B_{MSY} biomass threshold used to determine if the stock is overfished (Figure B2). Although both stocks are still below B_{MSY}, their condition has improved. The improvement is primarily due to growth of scallops in areas that were closed to fishing to protect groundfish, rather than increased recruitment. Increases in stock biomass were larger in the Georges Bank region; the area where closures were implemented earlier (i.e. 1994, Figure B6). Recruitment of scallops fluctuated around average values during 1995-1998 while stock biomass increased to the highest levels seen since 1991 (Figure B2).

The Mid-Atlantic stock is being exploited at or near the F_{MSY} overfishing threshold. Fishing mortality exceeds F_{MSY} and overfishing is occurring for the Mid-Atlantic stock (Figure B3).

Management Advice: For U.S. Georges Bank, fishing mortality should remain below F_{MSY}. Fishing mortality should be reduced below F_{MSY} in the Mid Atlantic region. Closed areas and reductions in fishing effort in the U.S. Georges Bank region resulted in improved stock condition (primarily in the closed areas, which contain most of the biomass; Figure B5). Further rebuilding can be expected if fishing mortality remains low. Fishing mortality should be reduced in the Mid-Atlantic region to end overfishing and rebuild the stock. Because growth overfishing is occurring in open areas of both the Georges Bank and Mid Atlantic regions, effort reductions in open areas should result in increased yields.

Area closures have been shown to be effective ways to reduce stock-wide fishing mortality and catch of sea scallops and to increase stock biomass in the closed areas. Area closures, particularly on Georges Bank, have resulted in progress towards rebuilding the stocks and reducing overfishing. The current harvesting capacity of the fleet is capable of rapidly depleting the sea scallop resource. Plans to reopen closed areas should thus proceed with caution. In 1998, the percentage of total scallop biomass in closed areas was 90% for the U.S. Georges Bank region, 50% for the Mid-Atlantic Bight region, and 80% for the areas combined (Figure B5). Heavy fishing in open areas may reduce scallop biomass in open areas to very low levels. This might occur without overfishing the entire scallop stocks given current definitions in the fishery management plan. If closed area management harvest policies are adopted, definitions of overfishing and management procedures for stocks need to be re-examined *(see Special Comments)*.

Forecast for 2000: No forecasts were performed.

Landings and Status Table (weights in mt, survey density in average grams per tow): Sea scallop

Year	1990	1991	1992	1993	1994	1995	1996	1997	1998	Min[4]	Max[4]	Mean[4]
Landings												
Georges Bank	9,982	9,311	8,238	3,655	1,137	982	2,045	2,326	2,064[2]	982	9,982	4,701
Mid-Atlantic	6,435	7,011	4,955	2,778	5,872	6,318	4,999	2,910	2,778[2]	1,610	7,973	4,891
Other[1,3]	690	676	846	863	525	665	773	699	1,133[2]	393	1,137	702
US Total	17,107	16,998	14,039	7,296	7,534	7,965	7,817	5,935	5,975[2]	5,936	17,107	10,295
Density of Partial Recruits[5] (number per tow, 42-87 mm shell height)												
Georges Bank	128	218	184	43	20	95	73	29	136	15	218	82
Mid-Atlantic	177	48	24	134	98	131	24	32	156	15	177	78
Density Abundance of Full Recruits[5] (number per tow, > 88 mm shell height)												
Georges bank[6]	71	51	75	21	24	28	70	69	164	21	164	52
Mid-Atlantic	88	54	28	25	64	93	52	26	52	18	99	52
Swept Area Biomass												
Georges bank[6]		6.572		2.522	2.247	3,799	7,087	8,184	20,219	2.247	20.219	5.877
Mid-Atlantic				4.191			4,333	3,058	6,561	2.566	9.494	5.491
Fishing Mortality Rate[3]												
Georges bank[6]	1.31	1.19	0.85	1.22	0.43	0.22	0.24	0.24	0.09[2]	0.09	1.31	0.77
Mid-Atlantic	0.48	0.92	1.14	0.47	0.71	0.50	0.81	0.67	0.30[2]	0.30	1.14	0.66

1: Includes Gulf of Maine, South New England, and other areas.
2: Incomplete, data to October, 1998.
3: Rescaled trends in catch divided by survey biomass.
4: Data for 1982-1998, except landings (1982-1997).
5: NMFS survey data adjusted for selectivity of survey dredge
6: Whole stock (open plus closed areas).

Stock Distribution and Identification: Sea scallops range 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. Overall abundance in Southern New England and the Gulf of Maine is much lower. For assessment purposes, sea scallops are treated as two unit stocks because significant differences in growth and reproductive dynamics have been documented.

Catches: During 1982-1997, USA landings ranged 5,936 during 1997 to 17,107 mt in 1990 (Figure B1). Average USA landings during 1997-1998 were at the lowest level since 1982. On Georges Bank, landings peaked in 1990 and then decreased due to poor stock condition and area closures. Landings from the Mid-Atlantic region peaked in 1989 and then varied without trend around a lower mean in later years. In 1998, landings from the U.S. Gulf of Maine increased to 1,122 mt, but this may be due to errors in assigning catches to gear types or areas. Estimates of scallop catch in numbers may be unreliable because of problems with non-random sampling for estimation of average weight.

Data and Assessment: The primary assessment approach of the SARC embodies a simple examination of trends in survey data and catch biomass. A secondary assessment, based on a new model, showed similar trends, however, a number of technical problems were not resolved and the SARC chose not to use the results from the secondary assessment. Problems with the second model may reflect under-reporting, fishing mortality other than catch mortality, or both. There is also concern that problems with biological samples of catch weights may underestimate numbers caught. Changes in management and data collection procedures prevented use of commercial catch rate data as a measure of relative abundance in recent years.

Some caution is required in interpreting recent trends because the high relative biomass during 1998 measured by the survey data may have been due to high catch rates in a single survey stratum and a few survey tows. For this reason, Status Determinations are made on the basis of mean 1997-1998 estimates of fishing mortality and trawl survey abundance data.

Biological Reference Points: Biological reference points implemented in Amendment 7 of the Sea Scallop FMP defined proxies for B_{MSY} in terms of biomass (meat weight) per survey dredge tow, with values of 3.90 and 8.16 kg/tow, respectively, for the Mid Atlantic and Georges Bank regions. The proxy for F_{MSY} was set at F_{MAX}, determined to be 0.24 for both stocks. The values of F_{MAX} were revised incorporating new meat weight-shell height relationships (see special comments regarding uncertainty in biological parameters). The revised estimates of F_{MAX} are 0.17 - 0.21 for the Georges Bank region and 0.14 - 0.17 for the Mid-Atlantic area (Figure B4).

SFA Control Rule: The FMP control rule states that when biomass exceeds B_{MSY}, the overfishing threshold is F_{MSY}, and target F is 75%F_{MSY}. Below B_{MSY}, target F decreases linearly and is set to zero when stock size is at the biomass threshold of ¼B_{MSY}. For Status Determination purposes, F_{MAX} is used as a proxy for F_{MSY}. The biomass per recruit corresponding to F_{MAX}, scaled by the magnitude of survey recruitment estimates, is used as a proxy for B_{MSY}.

Fishing Mortality: Fishing mortality rate estimates are based on simple calculations involving catch and survey data. In the Georges Bank stock region, fishing mortality rates for sea scallop averaged 1.0 during 1982-1993 and then declined to about 0.54 during 1997-1998 in areas open to fishing and to about 0.16 for the stock region as a whole (Figure B3). The estimate for 1998 was 0.09, which may be too low due to a few large survey catches in stratum 54 (see Data and Assessment). In the Mid-Atlantic region, fishing mortality rates fluctuated without trend during 1982-1998 around a mean value of 0.66 (Figure B3). The mean 1997-1998 F in the Mid-Atlantic region was 0.48.

Recruitment: Recent recruitment has fluctuated around average levels in the Georges Bank and Mid-Atlantic Bight regions.

Stock Biomass: Spawning stock biomass estimates were not computed but likely reflect the same trends as fully-recruited biomass indices calculated from the NMFS survey. Swept area biomass estimates show an increasing trend since 1995 for the U.S. Georges Bank area, with a mean 1997-1998 value of 14,201 mt. For the Mid-Atlantic, the mean 1997-1998 swept area biomass estimate was 4,810 mt (Figure B2).

Special Comments: Uncertainty in biological parameters with respect to age and size of scallops entering the fishery has a substantial influence on biomass per recruit and thus the absolute level of the B_{MSY} proxy. Additional growth and selectivity information is needed to better characterize biomass targets.

Depletion experiments, such as those carried out recently on Georges Bank, are very useful in stock assessment and management of scallops. Future work should be directed at characterizing dredge efficiency on different types of bottom and developing an inventory of bottom types. This information will help apply results of depletion study experiments to larger stock areas.

Analysis of depletion study results suggests that there may be significant non-yield mortality of scallops due to dredges. This type of non-catch, fishery-induced mortality is likely proportional to total fishing effort and may be important both to managers and in stock assessment work.

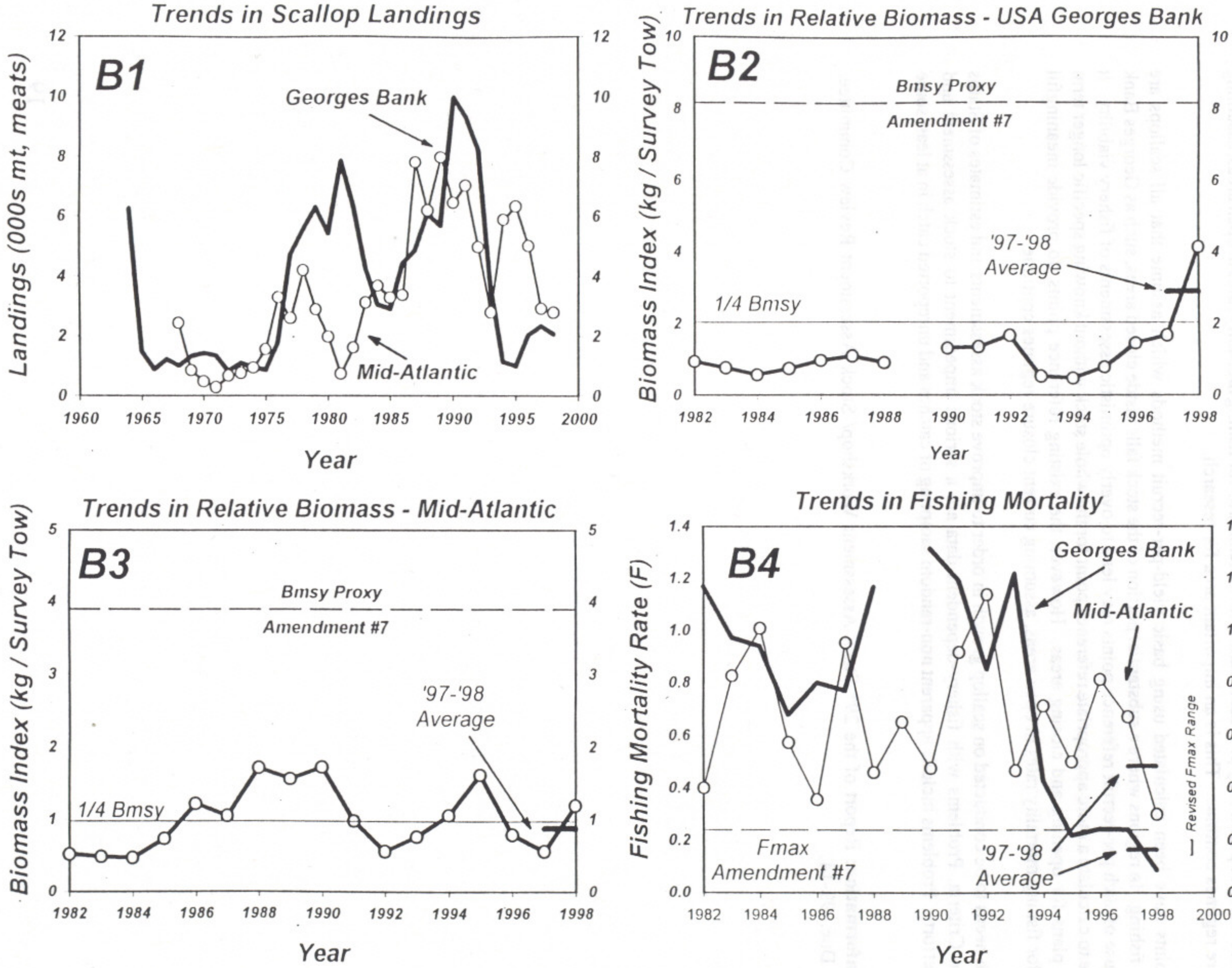
Reference points based on equilibrium per-recruit computations, such as F_{max} which is used as a proxy for F_{MSY} in Amendment 7, may be inappropriate to make inferences about an entire stock when some areas are closed to fishing. However, these reference points may provide meaningful benchmarks for fishing mortality rates in open areas, assuming current closure regimes continue. This is an important area for research.

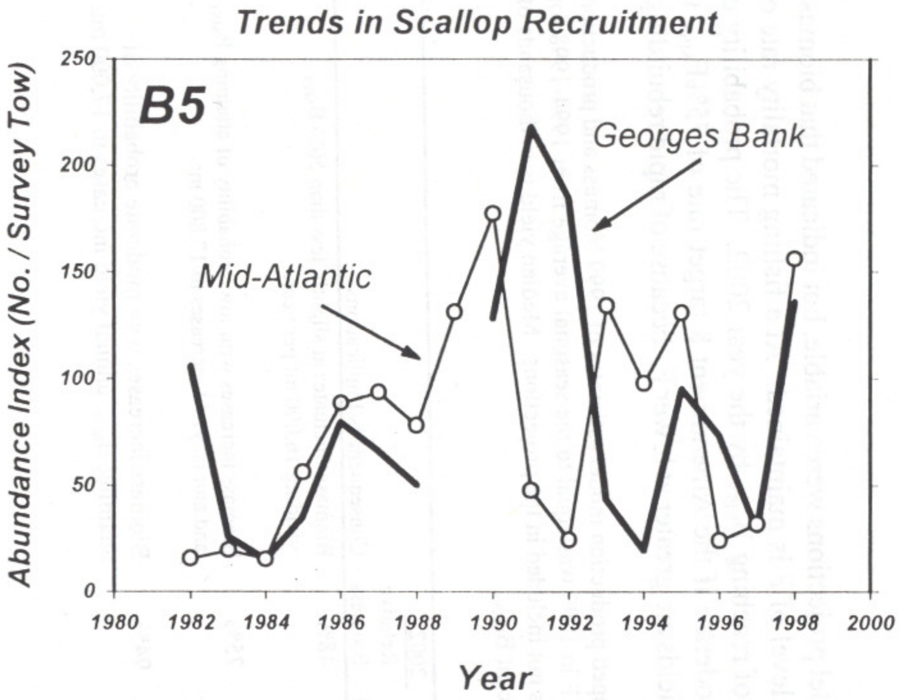
Reference points have been calculated using basic yield-per-recruit methods which assume that all scallops are vulnerable to fishing. In regions where a substantial portion of the stock falls inside closed areas, such as Georges Bank (Figure B5), use of such per-recruit reference points may lead to overly optimistic assessments of fishery viability. It is not possible to calculate a more appropriate reference point for the whole stock without knowing specific longer term management plans for opening and closing areas. However, the existing reference points do provide meaningful benchmarks for fishing mortality rates in open areas, assuming current closure regimes continue.

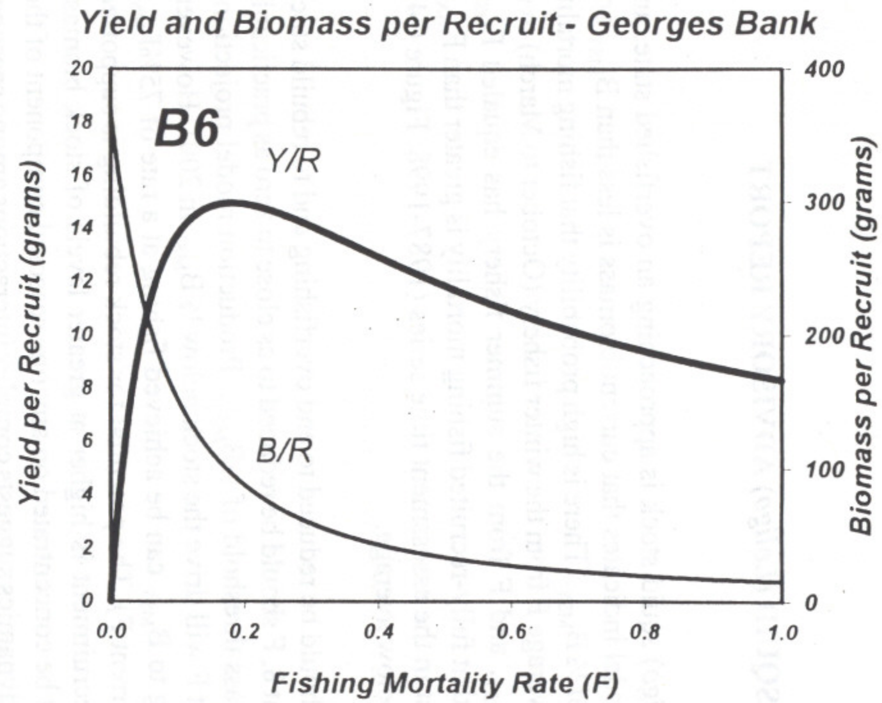
More research needs to be conducted on scallop growth in order to improve stock assessments and estimates of Status Determination Criteria. Problems with fishery-dependent data are a serious impediment to stock assessment and management efforts. Problems include apparent non-random sampling of catches and unreported catch in at least some years.

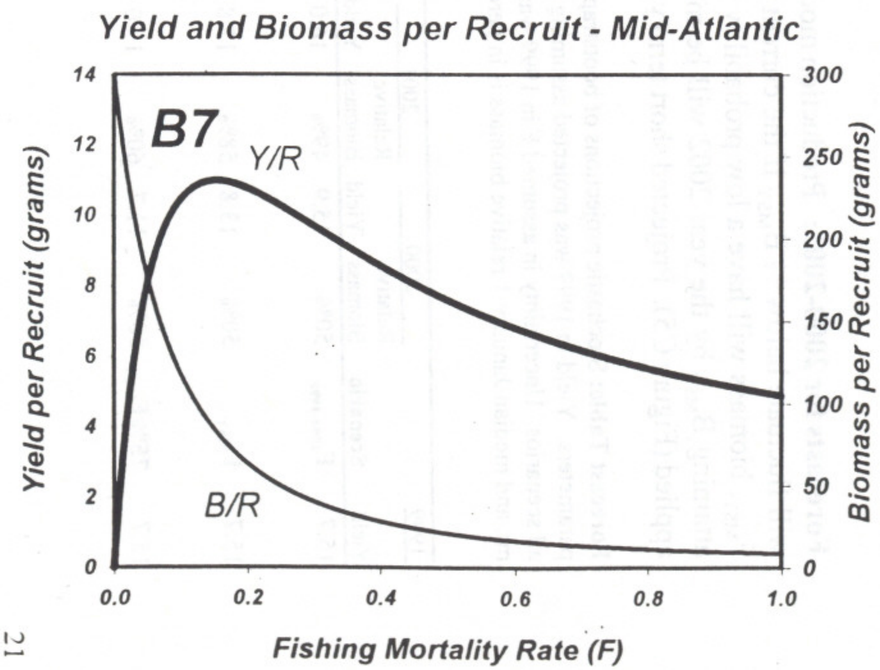
Sources of Information: Report of the 29th Stock Assessment Workshop/ Stock Assessment Review Committee. NEFSC Ref. Doc. 99-14.

Georges Bank - Mid-Atlantic Sea Scallop




Trends in Scallop Recruitment
B5
Georges Bank
Mid-Atlantic
Abundance Index (No. / Survey Tow)
Year


Yield and Biomass per Recruit - Georges Bank
B6
Y/R
B/R
Yield per Recruit (grams)
Biomass per Recruit (grams)
Fishing Mortality Rate (F)


Yield and Biomass per Recruit - Mid-Atlantic
B7
Y/R
B/R
Yield per Recruit (grams)
Biomass per Recruit (grams)
Fishing Mortality Rate (F)

C. INSHORE LONGFIN SQUID (*Loligo*) ADVISORY REPORT

State of Stock: The inshore longfin (*Loligo*) squid stock is approaching an overfished state, and overfishing is occurring. A production model indicates that current biomass is less than B_{MSY} and near the Amendment 8 biomass threshold of ½ B_{MSY}. There is high probability that fishing mortality exceeded F_{MSY} in 1998 (Figure C2). The average F from the winter fishery (October to March) over the last five years averaged 180% of F_{MSY}, and F from the summer fishery has equaled F_{MSY}. Additional length-based analyses indicate that fully-recruited fishing mortality is greater than F_{MAX}, and that stock biomass is among the lowest in the assessment time series (1987-1998; Figure C4). Recent survey indices of recruitment are below average.

Management Advice: Fishing mortality should be reduced to end overfishing and to rebuild stock biomass to B_{MSY}. According to Amendment 8, F should be reduced to as close to zero as practicable if the stock size decreases below the biomass threshold of ½B_{MSY}. Production model projections suggest that continued fishing at the current F will drive the stock below ½ B_{MSY} in 2001. However, projections also show that rapid rebuilding to B_{MSY} can be achieved fishing at a rate of 75%F_{MSY} (equivalent to a 71% reduction from the current F). The potential for stock rebuilding is supported by the survey data which indicates that recruitment is higher at greater levels of stock biomass (Figure C9). Total annual catch should not be concentrated on any one seasonal component of the stock, because information on reproductive dynamics suggests complex interactions among seasonal cohorts.

Forecasts for 2000-2002: Production model projections were variable, but indicated that biomass will fluctuate below ½ B_{MSY} if the current level of F is maintained. At a fishing mortality rate of F_{MSY}, biomass will have a low probability of reaching B_{MSY} by the year 2002. The probability of attaining B_{MSY} by the year 2002 will be moderate if the Amendment 8 target rate of 75%F_{MSY} is applied (Figure C5). Projected short term yields are greater at lower F, because of rapid rebuilding.

Forecast Table: Stochastic projections of bootstrapped production model estimates of 1999 biomass and production parameters. Yield in 1999 was projected assuming F in 1999 was equal to the seasonal average from 1994-1998 for all scenarios. Uncertainty in assumed F in 1999 was not included in the projections. Median yield is in thousands of mt, and median January 1 relative biomass is in percent B_{MSY}.

1999		2000		2001		2002	
		Relative		Relative		Relative	
Yield	**Scenario**	Biomass	Yield	Biomass	Yield	Biomass	Consequences/Implications
15.7	**$F_{1994\text{-}1998}$**	50%	15.9	49%	16.0	48%	Biomass fluctuates at slightly less than 50% B_{MSY} yielding 16,000 mt per year.
15.7	**F_{MSY}**	50%	13.8	58%	17.8	75%	Biomass increases with low probability of attaining B_{MSY} and annual yield increases to 17,800 mt.
15.7	**75%F_{MSY}**	50%	11.7	60%	17.0	94%	Biomass increases with moderate probability of attaining B_{MSY}, annual yield increases to 17,000 mt.

Catch and Status Table (landings in thousand mt, biomass in percent B_{MSY}): Inshore Longfin Squid

Year	1992	1993	1994	1995	1996	1997	1998	1999	Max[1]	Min[1]	Mean[1]
Winter Landings[2]	13.4	16.1	14.6	11.1	6.4	10.6	15.3	----	15.6	4.3	11.2
Summer Landings[3]	5.6	6.5	8.9	7.8	5.7	5.7	3.1	----	11.0	3.1	7.1
Discards	(Not	Available)									
Annual Catch	19.0	23.0	23.5	18.9	12.0	16.3	18.4	----	37.6	0.6	17.1
Survey Biomass[4]	64	51	31	89	36	27	42		96	27	55
Relative biomass[5]	107%	110%	84%	66%	53%	63%	74%	57%	124%	36%	77%
Winter F[6]	2.2	2.4	2.2	2.2	1.9	3.0	2.5	----	3.0	1.4	2.2
Exploitation Rate[6]	81%	83%	81%	81%	77%	87%	83%	----	83%	66%	80%
Summer F[7]	0.7	1.3	1.4	1.4	1.1	1.5	1.1	----	1.4	0.5	1.0
Exploitation Rate[7]	43%	64%	67%	66%	58%	70%	59%	----	66%	34%	56%
Exploitation Index[8]	0.50	0.52	0.42	0.35	0.80	0.35	0.76	----	0.80	0.35	0.53
Relative F[9]	92%	140%	133%	164%	125%	110%	171%	----	171%	61%	114%

[1] Over the period 1963-1998 for annual catch. 1968-1998 for survey biomass. 1987-1999 for seasonal catch. relative biomass. F and exploitation rates. 1992-1998 for exploitation indices.
[2] First and fourth quarters.
[3] Second and third quarters.
[4] Combined fall and following spring area-swept estimates for comparison to Amendment 8 B_{MSY} proxy of 80 k mt.
[5] Jan. 1 biomass. in percent B_{MSY} from production model.
[6] Monthly rate: October to March. labeled by calendar year in January. fully-recruited sizes.
[7] Monthly rate: April to September. fully-recruited sizes.
[8] Annual average of quarterly catch to survey index ratios for NEFSC winter. spring and fall surveys.
[9] In percent F_{MSY} from production model.

Stock Distribution and Identification: Within its range of commercial exploitation (Southern Georges Bank to Cape Hatteras) the population is considered to be a unit stock. It appears that a portion of the stock occurs south of traditional fishing areas, particularly during winter.

Catches: Estimated landings increased rapidly in the 1960s and early 1970s to a peak of 38,000 mt in 1973, with nearly all landings from distant water fleets. Catches from the traditional inshore fishery, which occurs during summer, have decreased from relatively high levels in the late 1980s. During the 1980s, a domestic offshore fishery developed in winter months and replaced the foreign fishery. Catches from the offshore, winter fishery have generally increased since the late 1980s. Landings in 1998 were approximately equal to average annual landings from 1967 to 1998 (18,400 mt), with most landings taken offshore in the first quarter. The magnitude of Loligo discards appears to be relatively low based on limited sea sampling information.

Data and Assessment: The stock assessment is based on commercial landings, a summary of research survey indices, length-based virtual population analysis (LVPA) and dynamic surplus production analyses.

Biological Reference Points: Reliable estimates of F_{MSY} and B_{MSY} are not available, but relative ratios of biomass and F estimates to MSY conditions may be more reliable. Yield-per recruit analyses were updated with revised information on exploitation pattern from the LVPA. The monthly rate of natural mortality was assumed to be 0.3. For the winter fishery (summer-hatched squid), F_{MAX} = 1.2 and $F_{0.1}$ = 0.6; for the summer fishery (winter-hatched squid), F_{MAX} = 0.7 and $F_{0.1}$ = 0.4 (Figure C4). Yield per recruit reference points are monthly instantaneous rates.

SFA Control Rule: The Amendment 8 control rule states that when the stock biomass exceeds B_{MSY}, the overfishing threshold is F_{MSY}, and target F is 75% F_{MSY}. Below B_{MSY}, target F decreases linearly and is set to zero when stock size is at the biomass threshold of ½ B_{MSY} (Figure C6).

Fishing Mortality: Monthly fishing mortality rates on fully recruited sizes (19-24 cm mantle length) averaged 1.6 over the entire time series, but were consistently lower in summer than in winter, and have generally increased since 1991. Fishing mortality on total biomass was also greater in winter than in summer. The frequency of exceeding F_{MSY} increased from the late 1980s and early 1990s to the mid to late-1990s (Figure C2). The 80% confidence interval of the current F estimate is 107% F_{MSY} to 296% F_{MSY} (Figure C8).

Recruitment: Recent survey indices of recruitment (≤ 8 cm ML) are below average in all seasons. Recruitment is related to stock biomass six months earlier, as estimated by area swept biomass and abundance estimates (Figure C9).

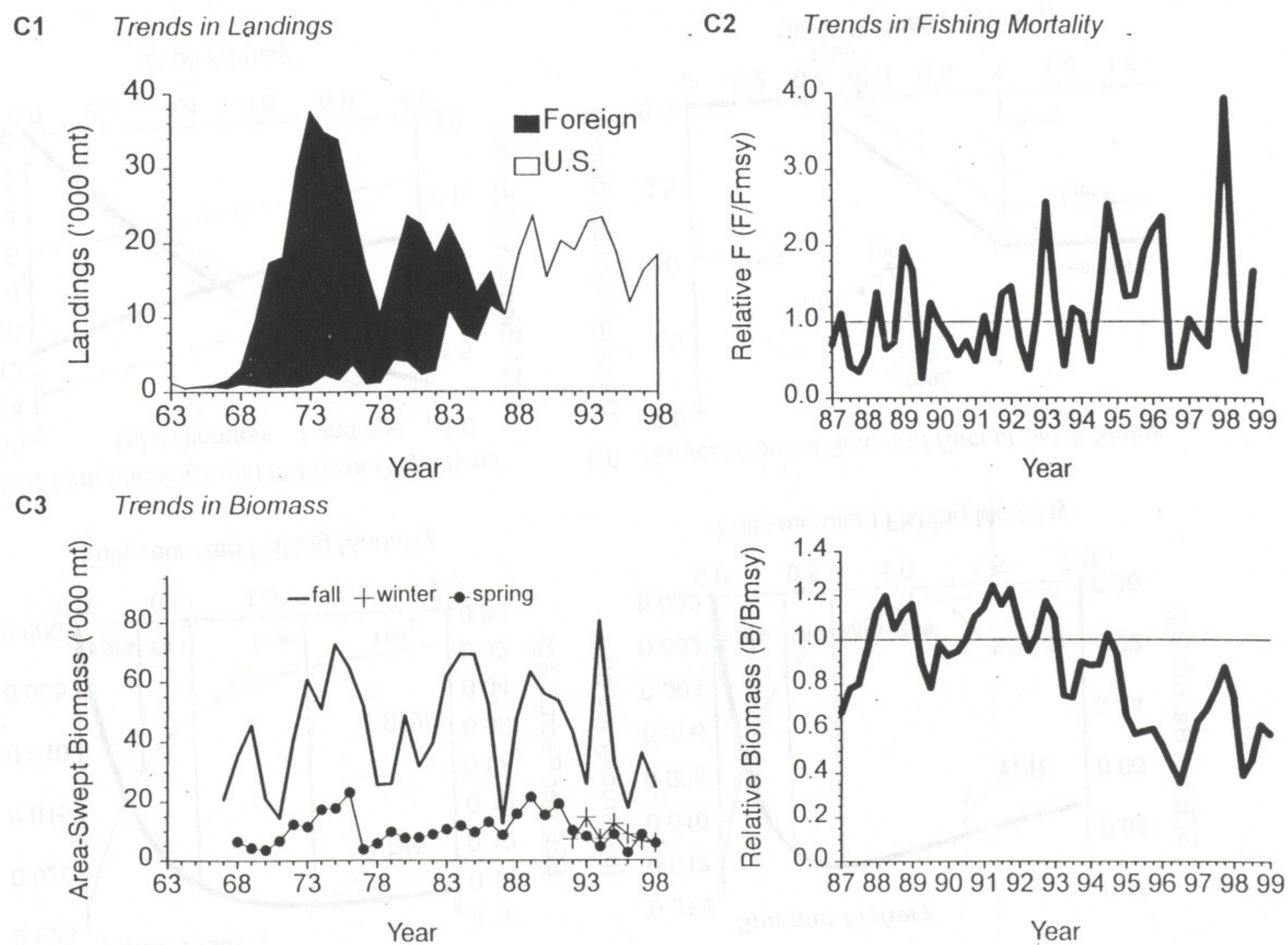
Stock Biomass: Stock biomass fluctuated around B_{MSY} from the late 1980s to the early 1990s, decreased to low levels in the late 1990s, and was approximately 60% of B_{MSY} at the beginning of 1999. The 80% confidence interval of current biomass estimate is 27% B_{MSY} to 94% B_{MSY} (Figure C7).

Special Comments: Although advances have been made in understanding the life history of *Loligo pealeii*, data on age and growth are extremely variable. Length-based population estimates may not be reliable, because they are sensitive to differences in assumed growth rates. The surplus production model explains only a small portion of the variance in biomass indices, and survey catchability estimates from the model are probably unrealistic. Sensitivity analyses, assuming lower catchability, indicate that production model results may be overly optimistic.

The Amendment 8 control rule may not be appropriate for this stock. The apparent resilience of this stock is high, suggesting that it can rebuild quickly from low stock sizes at low to moderate F. Thus, a target F of zero at ½ B_{MSY} may be overly conservative. In addition, F_{max} may be a risk prone proxy for F_{MSY}, because it is poorly determined and ignores a stock recruitment relationship. Additive swept-area estimates may be a poor proxy for B_{MSY}.

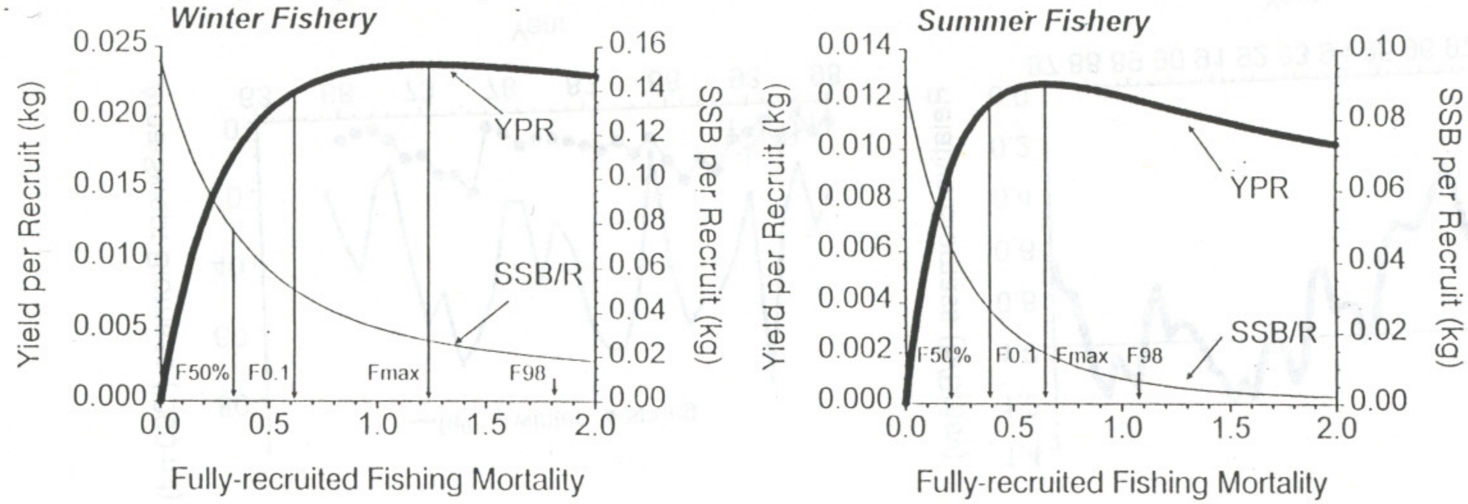
Source of Information: S. Cadrin and E. Hatfield. 1999. Stock Assessment of Longfin Inshore Squid *Loligo pealeii*. NEFSC Ref. Doc. 99-12.

Inshore Longfin Squid

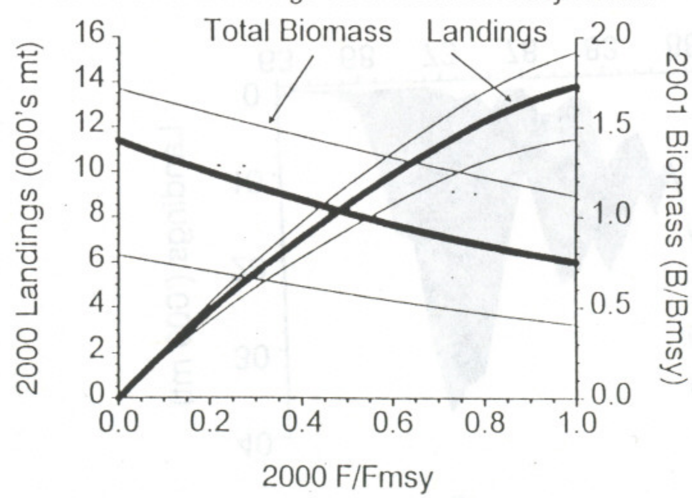


Inshore Longfin Squid

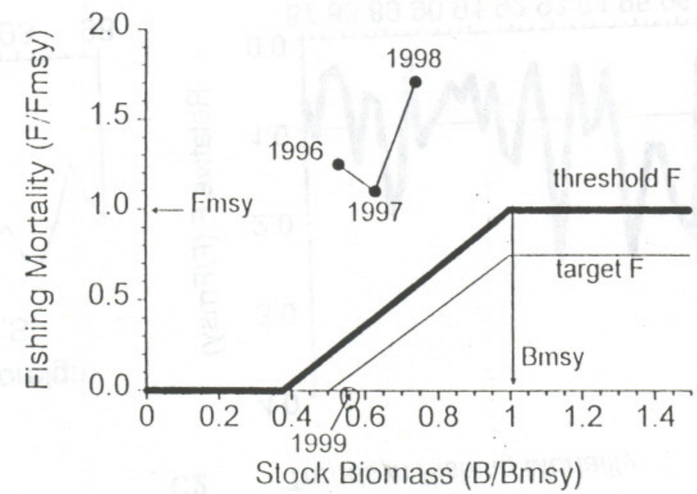
C4 *Yield and Spawning Biomass per Recruit*



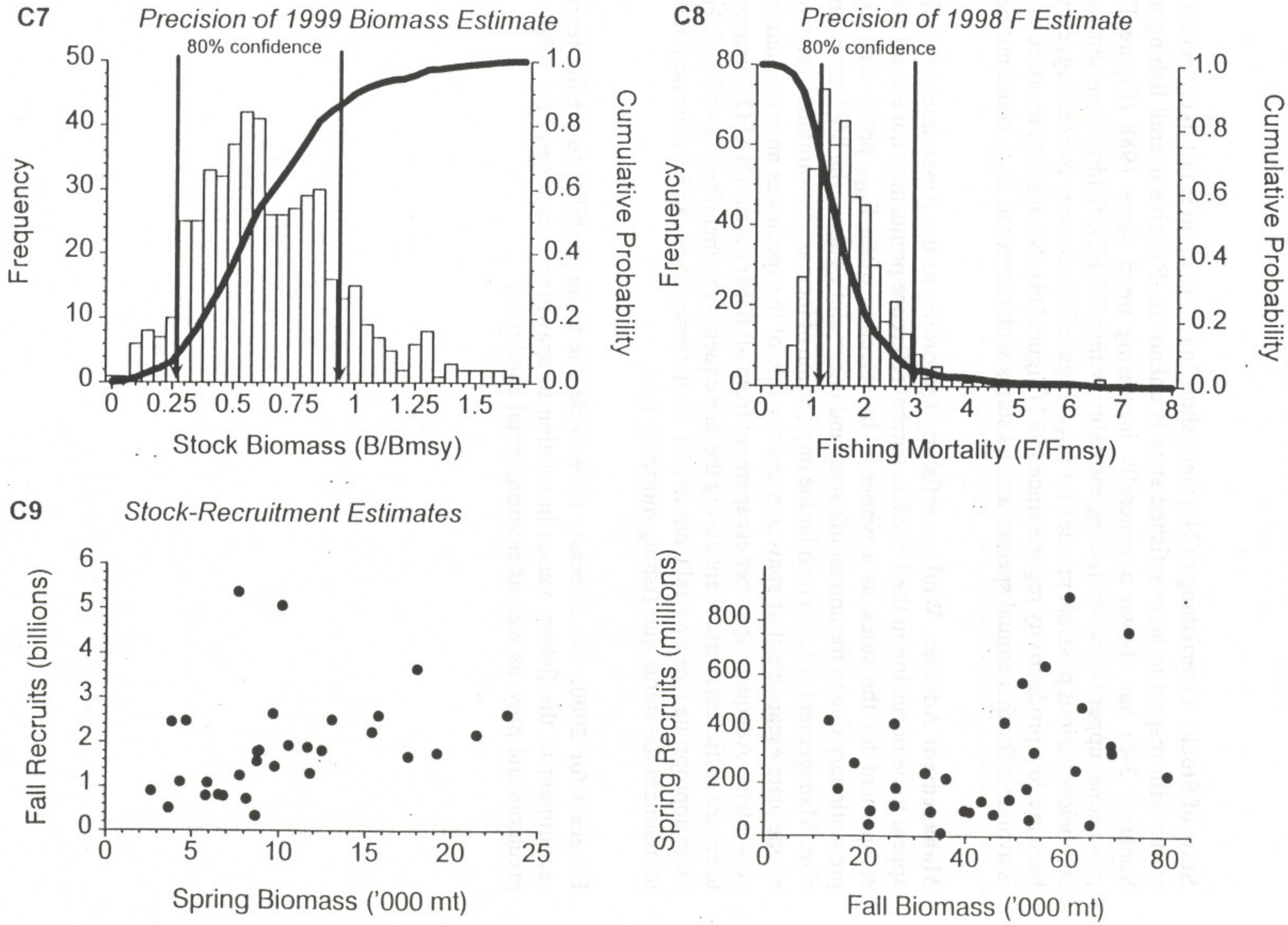
C5 *Short-term Landings and Biomass Projections*



C6 *Harvest Control Rule and Recent Stock Status*



Inshore Longfin Squid



D. NORTHERN SHORTFIN SQUID (*Illex*) ADVISORY REPORT

State of Stock: Overfishing of Northern shortfin (*Illex*) squid is not likely occurring but the stock status with respect to an overfished state is unknown. Relative overall fishing mortality (NAFO Subareas 3-6) has shown a generally increasing trend since 1988 (Figure D7). However, a provisional upper bound on fishing mortality within US EEZ fishing areas during 1994-1998 was still below various possible proxies for F_{MSY} (Figure D2). Survey indices suggest that the stock has been in a low productivity regime since 1982 (Figure D6). No absolute measure of stock abundance is available for this annual species and its status with respect to B_{MSY} could not be assessed.

Management Advice: While overfishing (according to the Amendment 8 definition) does not appear to be occurring in the US EEZ, current reference points may not ensure adequate spawning escapement for the stock as a whole. The selection of an F_{MSY} proxy and target F should be precautionary due to the annual life span and uncertainties about the life history and absolute stock size. Management should consider the implication of increased exploitation relative to the necessity of adequate escapement of spawners and the role of the species as an important forage item in the ecosystem. Adequate spawner escapement from all fishery areas (NAFO Subareas 3-6) is required to ensure sufficient recruitment during the subsequent year, therefore, %MSP reference points would seem appropriate (see Special Comments). Until these issues can be addressed, it would be prudent to maintain the status quo fishing mortality rate.

Forecast for 2000: No forecasts were made due to the inability to predict recruitment. Annual recruitment to the fishery varies in relation to spawning escapement, the relative abundance of predators and prey, as well as environmental conditions.

Landings and Status Table (weights in '000 mt): Northern Shortfin Squid

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Max	Min	Mean
US EEZ Domestic Landings[1]	5.0	5.2	10.3	2.0	6.8	11.3	11.9	17.8	18.0	18.4[a]	14.1	17.0	13.6	22.7	22.7	0.2	10.1
US EEZ Foreign Landings[2]	1.1	0.3	0	0	0	0	0	0	0	0	0	0	0	0	24.7	0.9	7.0
Total US EEZ Landings[3]	6.1	5.4	10.3	2.0	6.8	11.3	11.9	17.8	18.0	18.4[a]	14.1	17.0	13.6	22.7	24.9	0.4	9.2
Subarea 3+4 Landings[4]	0.7	0.1	0.6	0.8	7.0	11.0	4.0	2.0	2.7	6.0	1.0	8.7	14.5	1.9	162.1	0.6	17.6
Escapement Index in Numbers, US Fall[5] (number/tow)	2.4	2.1	15.8	23.2	22.4	16.6	5.2	8.2	10.4	6.8	8.0	10.8	5.8	14.6	27.1	0.6	9.3
Escapement Index in Biomass, US Fall[5] (kg/tow)	0.4	0.3	1.5	3.0	3.3	2.4	0.7	0.8	1.6	0.9	0.7	0.9	0.5	1.4	9.3	0.1	1.8
Average squid weight, US Fall[5] (g)	147	119	92	121	118	141	129	98	159	128	84	87	89	94	327	84	161

[1]Min, max, mean for 1979-98.
[2]Min, max, mean for 1968-98.
[3]Min, max mean for 1968-98.
[4]Min, max, mean for 1968-98.
[5]Min, max, mean for US Fall Bottom Trawl Surveys during 1967-98.

Stock Distribution and Identification: The *Illex illecebrosus* population is assumed to constitute a unit stock throughout its range of exploitation from Cape Hatteras to Newfoundland. Stock structure may be complicated by the overlap of seasonal cohorts. This highly migratory, oceanic species tends to school by size and sex and, based on age validation studies, is an annual species.

Catches: During 1973-1982, total stock landings (NAFO Subareas 3-6) averaged 71,000 mt and were predominately taken from Subareas 3+4 (73%). During 1983-1989, total landings averaged only 9,179 mt, with 82% taken from the US EEZ. Since 1983, total landings have been dominated by the domestic fishery, with the exception of 1997. Prior to 1967, US commercial landings of squid (*Illex* and *Loligo*) averaged about 2,000 mt per year. A directed foreign fishery for *Illex* developed in 1967 in U.S. waters and continued through 1982 (Figure D1). Since 1987, there has been no foreign fishery for *Illex* within the US EEZ. Domestic landings increased during 1988-1994, to 18,350 mt in 1994, then averaged 14,900 mt during 1995-1997. In 1997, Subarea 3+4 landings were nearly equal to US EEZ landings and were at their highest levels since 1981. In 1998, US EEZ landings (22,700 mt) reached the highest level observed since 1977, when the distant water fleets were fishing, resulting in fishery closure as the TAC (19,000 mt) was exceeded.

Data and Assessment: *Illex illecebrosus* was last assessed in 1995 at SAW-21. Assessment of the U.S. population is hampered by the lack of information on abundance and distribution before and during the fishery. In addition, finer spatial and temporal resolution of fishery and biological data are needed. Weekly collection of total landings, catch rates and biological data are needed for in-season estimates of stock size and to allow in-season catch or effort adjustments.

The current assessment utilizes U.S. bottom trawl fishery mean weights of *Illex* squid, from 1994-1998, and landings and effort data from the logbook database. An upper bound on fishing mortality in the US fishing area was derived using a DeLury depletion estimator. A lower bound on fishing mortality was estimated by multiplying the upper bound from the fishing area by the fraction of *Illex* shelf-edge habitat which constitutes the fishing area (Figures D3 and D4). These data were also used in a yield-per-recruit analysis and to examine the applicability of depletion modeling for real-time management (see Special Comments). Trends in research survey indices of relative abundance and biomass were also examined and relative fishing mortality rates were computed based on the survey and commercial catch data.

Biological Reference Points: An adequate F_{MSY} proxy could not be established due to insufficient information. However, a yield-per-recruit analysis incorporating mean weights of squid from the U.S. fishery, supports the SAW-21 recommendation that $F_{50\%}$ may be an appropriate target fishing mortality rate. The 1994-1998 maximum estimate of fishing mortality suggests that the U.S. fishery is currently operating at or below this level (Figure D2). Ensuring adequate spawning stock escapement is of primary importance in the management of annual species with highly variable interannual recruitment. A %MSP reference point that would ensure adequate spawning stock escapement should be evaluated for management use.

SFA Control Rule: The Amendment 8 control rule states that when the stock biomass exceeds B_{MSY}, the overfishing threshold is F_{MSY}, and target F is 75% F_{MSY}. Below B_{MSY}, target F decreases linearly and is set to zero when stock size is at the biomass threshold of ½ B_{MSY}.

Fishing Mortality: Upper (F = 0.74) and lower (F= 0.24) bounds for average 1994-1998 fishing mortality rates in the US EEZ were computed (see Data and Assessment). These F values are below $F_{0.1}$ and at or below $F_{50\%}$ based on a yield-per-recruit analysis incorporating these same information (Figure D2).

Stock-based relative fishing mortality rates (SA 3+6 landings/average of SA 4 July and SA 5+6 Fall survey biomass indices) have generally increased since 1988 and have been at or above their 1982-1998 mean since 1994 (Figure D7).

Recruitment: Oceanographic conditions influence levels of recruitment and the distribution of recruits to fishery areas, and in particular, have been shown to affect *Illex* squid recruitment in the northern fishery in Subarea 3.

Stock Biomass: Current absolute stock size is unknown. The Subarea 4 research bottom trawl survey occurs in July, near the start of the U.S. fishing season, so it can be considered to represent a pre-fishery index. The SA 5+6 autumn survey occurs primarily after the U.S. fishery and can be considered a relative index of spawner escapement. Both surveys indicate that the stock has remained in a low productivity state since the 1976-1981 high productivity period (Figure D6). Another indication of a prolonged low productivity period is the drastic decline in survey mean weights which occurred in 1982, in both SA 5+6 (autumn) and SA 4 (July) (Figure D5). Mean weights in Subarea 5+6 have remained low since this time, and during 1995-1998, were at the lowest levels on record since 1967.

Special Comments: *Illex illecebrosus* is a highly migratory, transboundary species with an annual lifespan. The overfishing definition currently in place for this stock, F_{MSY}, is not only difficult to estimate given the available information, but may also perform poorly given the stock's characteristics. A %MSP reference point that accounts for the stock's life history and that would ensure adequate spawning stock escapement from all fishery areas should be evaluated for management use.

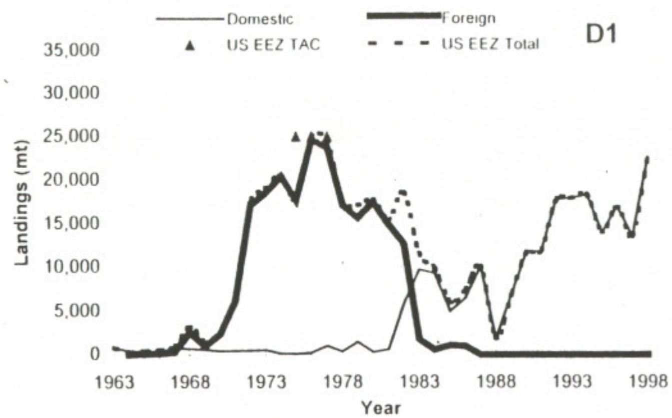
A pilot study of the feasibility of implementing real-time management (RTM) in the *Illex* fishery is being conducted during the 1999 fishing season, with approximately half of the predominate vessels participating. RTM would provide the fine-scale spatial and temporal resolution required to make in-season adjustments via catch or effort limitations. Such adjustments would ensure preservation of an adequate level of spawning biomass each year, avoid overfishing during periods of poor recruitment, and increase landings during periods of good recruitment.

For this SARC, several yield optimization scenarios involving differential weeks for opening the fishery were evaluated. The greatest increase in yield would result from harvesting a constant number of squid per week (at a larger size), but delays of greater than eight weeks (from week 20) would require up to twice as much total fishing effort to attain.

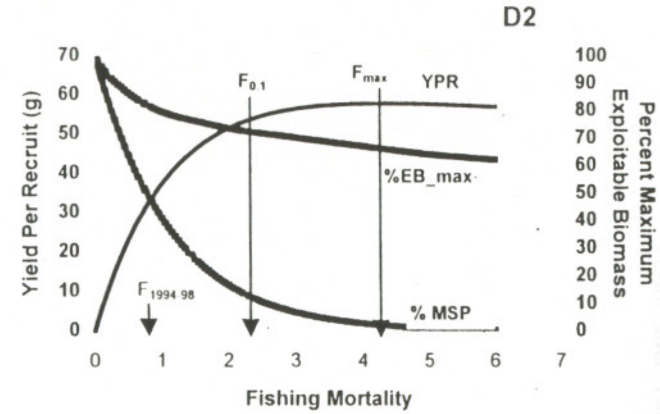
Sources of Information: Report of the 29th Northeast Regional Stock Assessment Workshop, Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 99-14); Report of the 21st Northeast Regional Stock Assessment Workshop, Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 96-05d); Hendrickson et al, 1996. Stock assessment of short-finned squid, *Illex illecebrosus*, in the Northwest Atlantic during 1993. (NEFSC Ref. Doc. 96-05g); Dawe E. G. and L. C. Hendrickson. 1998. A review of the biology, population dynamics, and exploitation of short-finned squid in the Northwest Atlantic Ocean in relation to the assessment and management of the resource. NAFO SCR Doc. 98-59.

Illex illecebrosus

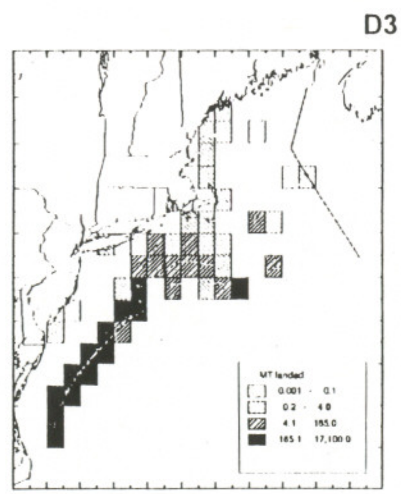
Trends in U.S. EEZ Commercial Landings and TACs



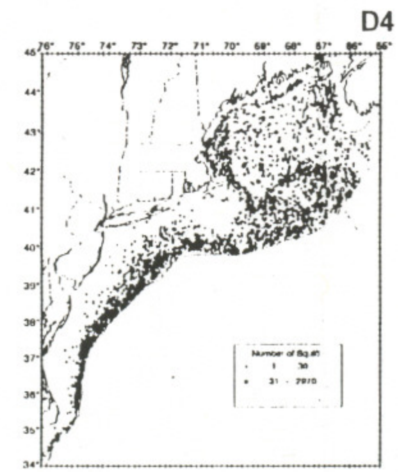
Yield/Recruit and Exploitable Biomass/Recruit
Based on 1994-1998 Exploitation Pattern



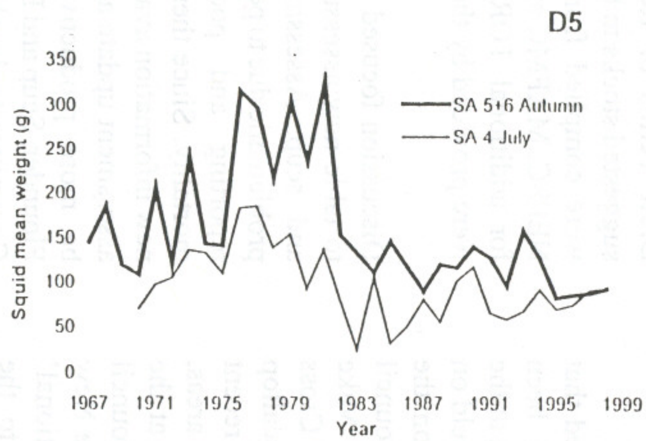
Subarea 5+6 *Illex* squid fishing areas, landings by quarter-degree square, during 1991-1993.



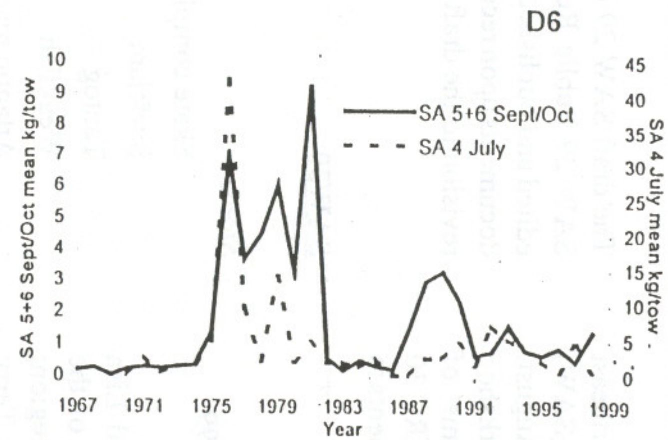
Illex squid habitat during the NEFSC autumn surveys, 1982-1998.



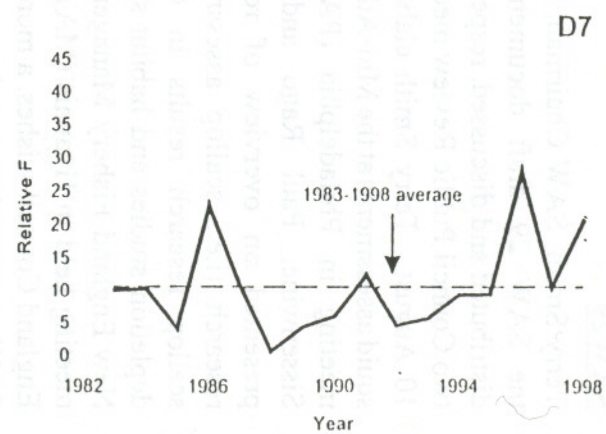
Trends in Subarea 4 and Subarea 5+6 *Illex* squid mean weight (g)



Trends in Research Survey Indices of Relative Biomass



Trends in Relative Fishing Mortality Rates for Subareas 3-6



CONCLUSIONS OF THE SAW STEERING COMMITTEE MEETING

The Steering Committee for the Northeast Regional Stock Assessment Workshop (SAW) met via teleconference on 23 August. Discussed was the Public Review Workshop for SAW 29, stocks and the Terms of Reference for assessment review at SARC 30 (December 1999) and potential assessments to be reviewed by SARC 31 (June 2000).

Teleconference of August 23, 1999

Participating were Jack Dunnigan and Lisa Kline of the ASMFC; Chris Kellogg of the NEFMC; Pat Kurkul of the Northeast Region; and Mike Sissenwine, Steve Murawski, Terry Smith (SAW Chairman), and Pie Smith (SAW Coordinator), NEFSC.

SAW29

Terry Smith, SAW Chairman, indicated that the SAW 29 draft documents had been distributed and discussed, respectively, at the two Council Public Review meetings held on 10 August. Terry Smith elaborated on the squid assessments at the Mid-Atlantic Council meeting in Philadelphia (PA) and Mike Sissenwine, Paul Rago and Jeff Cross presented an overview of recent scallop research (i.e., scallop assessments, recent scallop research results in closed areas, depletion studies and habitat studies) at the New England Fishery Management Council meeting held in Hyannis (MA). If the New England Council wishes, a more 'traditional' SAW presentation can be provided to the Council at their next meeting.

The draft SAW 29 Consensus Summary and SAW 29 Public Review documents will be edited and published as Laboratory Reference documents upon receiving any suggestions for revision to the draft text.

SAW30

Stocks

- Skate complex
- Surfclam
- Tautog
- Weakfish
- Atlantic mackerel

Discussion

Draft Terms of Reference (TOR) for the suggested stocks to be reviewed by SARC 30 were compiled from suggestions from the NEFSC, MAFMC and ASMFC. Suggestions for additional TOR for the skate complex were provided by the NEFMC.

Discussion focused on whether it was useful to table new assessments for black sea bass and scup. Assessing these stocks remain problematic due to perceptions of catch under-reporting and poorly estimated discard mortality. Since there will be no substantive new information available between the recent assessment update and the fall SARC it may be more productive to ask the Summer Flounder, Scup and Black Sea Bass Technical Committee to develop some new approaches to generating meaningful assessments for these two stocks. The more immediate concern with respect to Scup is estimating discard mortality and rebuilding schedules. Again, this should be placed on the agenda for the Summer flounder, Scup, and Black Sea bass Technical Committee

The tautog and weakfish assessments are being prepared by ASMFC's technical committees. Reports of the assessments, similar in format to the SAW working group working papers, will be prepared and made available to the SARC at the same time other working papers are provided.

A suggestion to add Atlantic mackerel to the list of assessments to be reviewed was accepted by the Steering Committee. The stock has not been assessed recently, an assessment is ready and there is US and Canadian interest in a joint assessment.

Meeting dates and places

SARC

November 29-December 3, 1999

NEFSC, Woods Hole, MA

PUBLIC REVIEW WORKSHOPS

ASMFC

January, 2000

TBA

NEFMC

January 19-20, 2000

Danvers, MA

MAFMC

January 25-27, 2000

Alexandria, VA

Terms of Reference

Skate Complex

(1) Summarize available biological studies (age and growth, maturity, etc.) for the seven species in the complex.

(2) Update commercial and recreational landings and survey indices through 1998/99.

(3) To the extent practicable, summarize fishery discard rates through the use of sea sampling data or other information sources.

(4) Estimate fishing mortality rates, and trends in relative or absolute stock size, and consider appropriate reference points for stock size and fishing mortality rate consistent with provisions of the Sustainable Fisheries Act.

(5) Provide an assessment of the status of the species in the complex relative to overfishing criteria, and evaluate the status of the barndoor skate resource relative to listing factors considered in the Endangered Species Act.

Tautog

(1) Summarize recreational and commercial landings by state (Massachusetts to Virginia).

(2) Summarize length composition, and available age-length data by region (Northern Region: Massachusetts, Rhode Island, Connecticut, New York; Southern Region: New Jersey, Delaware, Maryland, and Virginia).

(3) Summarize available indices of stock abundance by state based on state bottom trawl and juvenile surveys.

(4) Estimate age composition of recreational and commercial landings using age/length keys from the states of Massachusetts to Virginia

(5) Provide estimates of fishing mortality on a regional basis, and if possible for the "entire stock".

(6) Conduct, if possible, a full age-based VPA, and evaluate biomass parameters using yield-per-recruit, spawning-stock biomass-per-recruit, and a biomass dynamic model.

(7) Develop tag based estimates of fishing mortality if sufficient data exists.

(8) Review all options for targets for inclusion in the management plan and select appropriate biological reference points.

Weakfish

(1) Summarize life history, recreational and commercial landings and available age-length data by state (Florida to Massachusetts).

(2) Summarize available indices of stock abundance by state.

(3) Estimate age composition of recreational and commercial landings.

(4) Provide estimates of fishing mortality.

(5) Conduct a full age-based VPA and yield-per-recruit and spawning stock biomass-per-recruit and biomass dynamics analyses.

(6) Review progress towards meeting the goal in Amendment 3 to the Weakfish FMP to restore the age composition of the weakfish stocks.

(7) Review the biological reference points used for the overfishing definition and target fishing mortality rate.

(8) Evaluate ageing methodology based on scale and otolith analyses and provide recommendations on the most appropriate ageing method.

Mackerel

(1) Update the status of the Atlantic mackerel stock through 1999 and characterize the variability of estimates of stock size and fishing mortality rates.

(2) Provide projected estimates of catch for 2000 and SSB for 2001-2002 at various levels of F consistent with management targets and thresholds.

(3) Evaluate fishing mortality and biomass targets and thresholds consistent with requirements of the Sustainable Fisheries Act, and recommend changes, as appropriate.

Atlantic Surfclam

(1) For the Atlantic surfclam resource as a whole and by region, update status and characterize uncertainty in estimates of stock size and fishing mortality.

(2) Estimate MSY or MSY proxies for the stock as a whole and by region.

(3) Review assumptions of natural mortality, refine estimates of survey dredge efficiency, and work towards developing appropriate population models.

(4) Develop and recommend options for defining overfishing targets and thresholds for surfclam consistent with the requirements of the Sustainable fisheries Act. Determine the status of the resource with respect to appropriate overfishing targets for stock size and fishing mortality

SAW 31 (June 2000)

Stocks suggested for review during SAW 31 include Summer flounder, ocean quahog, monkfish, pollock, and bluefish.

Other Business

The Steering Committee discussed the timing of the US/Canada Transboundary Assessment Committee (TRAC) meetings. The next meeting is scheduled for spring 2000 with stocks to be assessed not yet agreed upon but likely to include sea herring and some of the Georges Bank groundfish stocks. The long term timing issue (whether to have a fall or spring meeting) has not been resolved and will be discussed with our Canadian counterparts in the next month.

Recently, there have been a number of peer-reviewed assessments outside the SAW process. These include the summer flounder assessment update done for the MAFMC and reviewed by that Council's S&S Committee. Since such assessments and peer reviews take place outside the SAW there is no documentation available subsequent to the peer review. The Steering Committee will explore whether or not such reports should be made part of the SAW series. Documents not peer-reviewed by the SARC should have an appropriate preface indicating the basis for the review.

More generally, there is a need to re-examine the current SARC/SAW model. Demand for reviews is increasing; the SFA requires annual stock status determination for each managed species; the SARC is limited to two one-week sessions a year. It was suggested that a review of other peer review systems would be helpful and that the Steering Committee should continue to discuss this issue during the fall/winter. Perhaps an evolutionary change in the process would be appropriate.

SAW 32 (December 2000)

Possible assessments to be reviewed by the SARC include sea scallops, whiting, redfish and Gulf of Maine haddock.

Research Communications Unit
Northeast Fisheries Science Center
National Marine Fisheries Service, NOAA
166 Water St.
Woods Hole, MA 02543-1026

STANDARD MAIL A

Publications and Reports of the Northeast Fisheries Science Center

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "planning, developing, and managing multidisciplinary programs of basic and applied research to: 1) better understand the living marine resources (including marine mammals) of the Northwest Atlantic, and the environmental quality essential for their existence and continued productivity; and 2) describe and provide to management, industry, and the public, options for the utilization and conservation of living marine resources and maintenance of environmental quality which are consistent with national and regional goals and needs, and with international commitments." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Those media are in three categories:

Scientific Information Reports -- These reports are irregularly issued in the ***NOAA Technical Memorandum NMFS-NE*** series. The series includes: data reports of long-term or large area studies; synthesis reports for major resources or habitats; annual reports of assessment or monitoring programs; documentary reports of oceanographic conditions or phenomena; manuals describing field and lab techniques; literature surveys of major resource or habitat topics; findings of task forces or working groups; summary reports of scientific or technical workshops; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing. Limited free copies are available from authors or the NEFSC. Issues are also available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA 22161.

Technical Information Reports -- These reports are irregularly issued in the ***Northeast Fisheries Science Center Reference Document*** series. The series includes: data reports on field and lab observations or experiments; progress reports on continuing experiments, monitoring, and assessments; background papers for scientific or technical workshops; and simple bibliographies. Issues receive internal scientific review but no technical or copy editing. No subscriptions. Free distribution of single copies.

Public Information Reports -- These reports are issued in two series: ***Fishermen's Report (FR)*** and ***The Shark Tagger (TST)***. The **FR** is a quick-turnaround report on the distribution and relative abundance of commercial fisheries resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. There is no scientific review, nor any technical or copy editing, of the **FR**; copies are available through free subscription. The **TST** is an annual summary of tagging and recapture data on large pelagic sharks as derived from the NMFS's Cooperative Shark Tagging Program; it also presents information on the biology (movement, growth, reproduction, etc.) of these sharks as subsequently derived from the tagging and recapture data. There is internal scientific review, but no technical or copy editing, of the **TST**; copies are available only to participants in the tagging program.

To obtain a copy of a scientific or technical information report, or to subscribe to a public information report, write: Research Communications Unit, Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543-1026. An annual list of NEFSC publications and reports is available upon request at the above address. Any use of trade names in any NEFSC publication or report does not imply endorsement.