Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW)

SAW Public Review Workshop

Report of the 20th SAW

NOAA/National Marine Fisheries Service
Northeast Fisheries Science Center
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OVERVIEW

The **SAW Public Review Workshop** of the 20th Northeast Regional Stock Assessment Workshop (20th SAW) was held in two sessions as part of the meeting agendas of the two northeast regional Fishery Management Councils. Session South was held during the Mid-Atlantic Fishery Management Council Meeting in Wilmington, Delaware on 2 August 1995 and Session North was held during the New England Fishery Management Council meeting in Danvers, Massachusetts on 10 August 1995.

The purpose of the workshop was to present to managers, industry representatives, and others the results of the peer review of assessments of on haddock, summer flounder, Atlantic mackerel, sea scallop, black sea bass, and tautog, as well as relevant management advice for the stocks assessed.

Presentations at both sessions were made by the 20th SAW Chairman, Dr. Terry Smith of the NMFS, Northeast Fisheries Science Center. At the beginning of each presentation, Dr. Smith described the SAW process, and reviewed the lists of participants in the series of Subcommittee meetings as well as the SARC meeting (see Tables 2 and 3 in the Conclusions of the SAW Steering Committee section of this report). The presentation material on the species was based on the Advisory Report section contained in this report. The presentation emphasis on the species/stocks was adjusted according to each Council's management interest in a particular species/stock.

Daft copies of the SARC Consensus Summary of Assessments and the Advisory Report on Stock Status were distributed to members of each Council and made available to other meeting participants at both sessions.
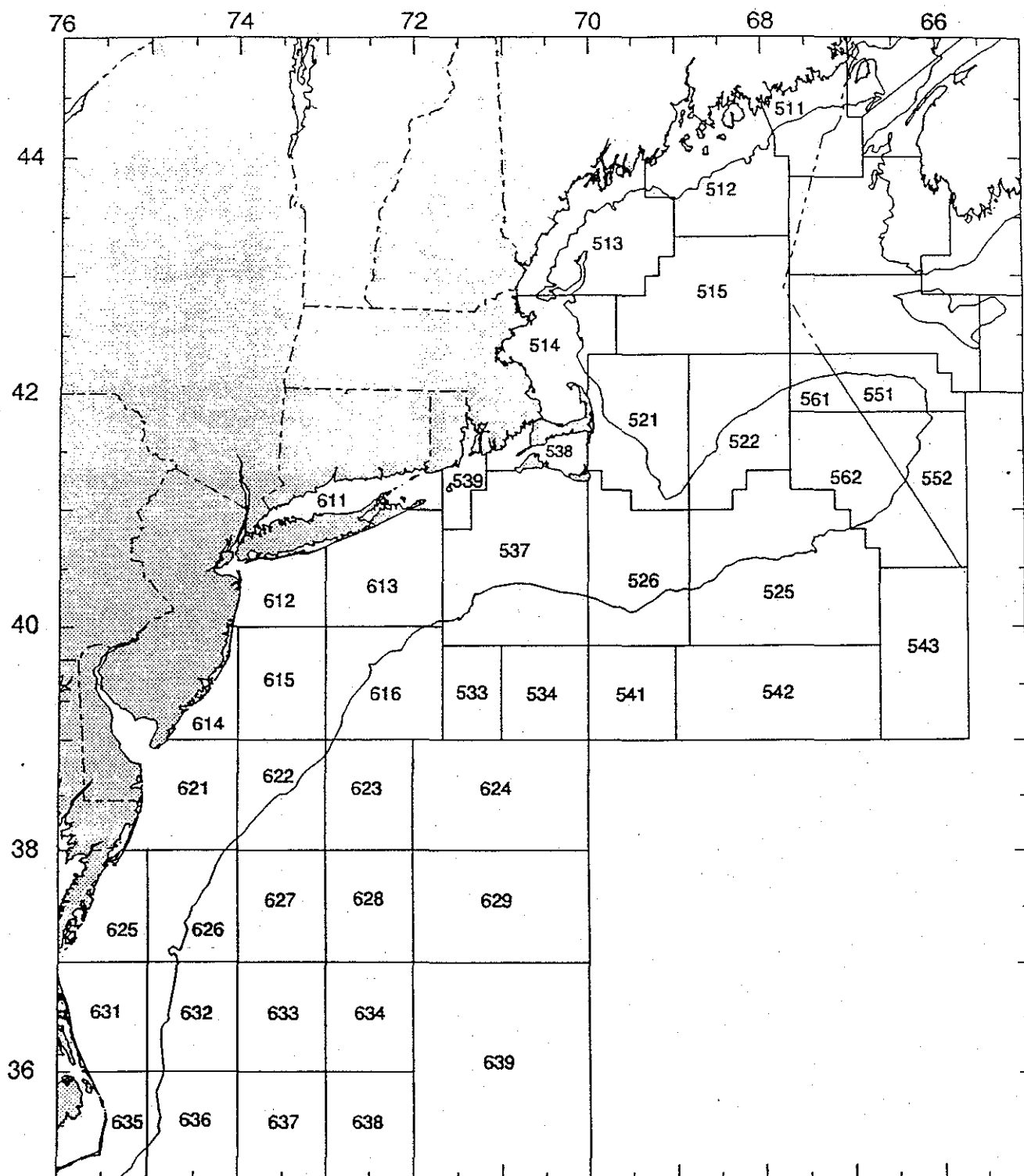
Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the northeast United States

INTRODUCTION

The **Advisory Report on Stock Status** is a major product of the Northeast Regional Stock Assessment Workshop. It summarizes the technical information contained in the Stock Assessment Review Committee (SARC), Consensus Summary of Assessments and is intended to serve as scientific advice for fishery managers on resource status. ~

An important aspect of scientific advice on fishery resources is the determination of whether a stock is currently over-, fully-, or under-exploited. As these categories specially refer to the act of fishing, they are best thought of in terms of exploitation rates relative to the Councils' overfishing and maximum sustainable yield (MSY) definitions. The exploitation rate is simply the proportion of the stock alive at the beginning of the year that is caught during the year. When that proportion exceeds the amount defined by the Councils' overfishing definition, it is considered to be over-exploited. When the stock is at such a level that the MSY can be taken but the fishery is only removing a small portion of the stock, then it is considered to be under-exploited.

Another important factor for classifying the status of a resource is the current stock level, for example, spawning stock biomass (SSB). It is possible that a stock that is not currently overfished in terms of present exploitation rates is still at a low biomass level due to heavy exploitation in the past. In this case, future recruitment to the stock is very important and the probability of improvement is increased greatly by increasing the SSB. Conversely, a stock currently at a high level may be exploited at a rate greater than the overfishing definition level until such time as it is fished down to a stock size judged appropriate for maximum productivity or desirable from an ecological standpoint. Therefore, where possible, stocks under review were classified as high, medium, or low biomass compared to historic levels. The figure below describes this classification.

		STOCK LEVEL		
		LOW	MEDIUM	HIGH
EXPLOITATION STATUS	OVER EXPLOITED	REDUCE EXPLOITATION REBUILD STOCK BIOMASS	REDUCE EXPLOITATION REBUILD AGE STRUCTURE	REDUCE EXPLOITATION INCREASE YIELD PER RECRUIT
	FULLY EXPLOITED	REDUCE EXPLOITATION REBUILD STOCK BIOMASS	MAINTAIN EXPLOITATION RATE AND YIELD	MAINTAIN EXPLOITATION RATE AND YIELD
	UNDER EXPLOITED	MAINTAIN LOW EXPLOITATION WHILE STOCK REBUILDS	INCREASE EXPLOITATION SLOWLY TO REFERENCE LEVEL	INCREASE EXPLOITATION TO REFERENCE LEVEL

Glossary of Terms

Biological reference points: Fishing mortality rates that may provide acceptable protection against *growth overfishing* and/or *recruitment overfishing* for a particular stock. The rate and points are usually calculated from equilibrium *yield-per-recruit* curves, spawning stock biomass-per-recruit curves and stock recruitment data. Examples are $F_{0.1}$, F_{MAX} and F_{MSY}.

Exploitation pattern: The pattern of fishing mortality on different age classes of the stock. 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 (F) and deaths due to all other causes (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 that we are interested in how many animals of an initial population of 1 million fish are alive at the end of one year. If we break the year up into 365 days (that is, the 'instant' of time is one day) then 2/365 or 0.548% of the population dies each day. On the first day of the year 5,480 fish die (1,000,000 x 0.00548), leaving 994,520 fish. On day 2, 5,450 fish die (994,520 x 0.00548) leaving 989,070 fish. At the end of the year there remain

134,593 fish (1,000,000 x (1-0.00548)$^{(365)}$). If, we had instead selected a smaller 'instant' of time, say an hour, at the end of the first time interval (an hour) 0.0228% of the population would have died and there would be 135,304 fish remaining at the end of the year (1,000,000 x (1-0.00228)$^{(8760)}$). As our instant of time becomes shorter and shorter the exact answer to the number of animals surviving is given by the survival curve mentioned above, or, in this example,

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

Exploitation rate: The proportion of a population 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 200,000 divided by 1 million or 20%.

F_{MAX}: The rate of fishing mortality that produces the maximum level of yield-per-recruit. This is the point where 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 percent of the yield-per-recruit produced by the first unit of effort on the unexploited stock (i.e., the slope of the yield-per-recruit curve for the $F_{0.1}$ rate is only one-tenth the slope of the curve at its origin).

F_{MSY}: The fishing mortality rate that maintains a stock at its maximum sustainable yield.

Growth overfishing: The rate of fishing above F_{MAX}; a rate of fishing at which weight loss due to mortality exceeds weight gain due to growth.

MSY: The largest average catch that can be taken from a stock under existing environmental conditions.

Recruitment: The number of fish added to the fishery each year due to growth and/or migration into the fishing area. For example, the number of fish that grow to become vulnerable to the fishing gear in one year would be the recruitment to the fishable population that year. This term can also refer to the number of fish from a year class reaching a certain age. For example, all fish reaching their second year would be age 2 recruits.

Recruitment overfishing: The rate of fishing above which the recruitment to the spawning stock becomes significantly reduced. 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.

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

Spawning stock biomass-per-recruit (SSB/R): The expected lifetime contribution to the spawning stock biomass for each recruit. An equilibrium value of SSB/R is calculated for each level of F for a given exploitation pattern, rate of growth, and natural mortality.

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

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

Virtual population analysis (or cohort analysis): A retrospective analysis of the catches from a given year class 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. For a given exploitation pattern, rate of growth, and natural mortality, an equilibrium value of Y/R is calculated for each level of F.

Table 1. Exploitation rates, percentage of stock (in numbers) caught annually, for different fishing mortality rates.

	Sea Scallop	Tautog	Georges Bank Haddock	Summer Flounder	Atlantic Mackerel	Black Sea Bass
M	0.10	0.15		0.20		
F						
0.1	9%	9%		9%		
0.2	17%	17%		16%		
0.3	25%	24%		24%		
0.4	31%	31%		30%		
0.5	38%	37%		36%		
0.6	43%	42%		41%		
0.7	48%	47%		46%		
0.8	53%	52%		51%		
0.9	57%	56%		55%		
1.0	61%	59%		58%		
1.1	64%	63%		62%		
1.2	67%	66%		65%		
1.3	70%	69%		67%		
1.4	73%	71%		70%		
1.5	75%	73%		72%		
1.6	77%	76%		74%		
1.7	79%	77%		76%		
1.8	81%	79%		78%		
1.9	82%	81%		79%		
2.0	84%	82%		81%		

A. GEORGES BANK HADDOCK (Division 5Z and South) ADVISORY REPORT

State of Stock: The stock is at a low biomass level and is considered to be fully exploited. Although the current estimate of the fishing mortality rate ($F_{1994} = 0.29$, 23% exploitation rate) is below the overfishing definition ($F_{30\%} = 0.35$, 27% exploitation rate), the stock remains in an overfished and a collapsed condition. Spawning stock biomass in 1993 was the lowest on record, increased in 1994 and 1995, and is expected to continue to increase in 1996 and 1997. Except for the 1992 year class, recruitment has been average or below average since 1987. Fishing mortality rates increased in 1992 and 1993, but declined in 1993 and 1994 due to the combined effects of the above-average 1992 year class and the restrictive management measures imposed in 1994. NEFSC bottom trawl survey biomass indices have increased slightly since 1991 but continue to remain among the lowest on record.

Management Advice: This stock remains in a collapsed condition. Therefore, fishing mortality should be held as low as possible. Reductions in F will increase the prospects for further rebuilding of SSB (Figure A7). The 1992 year class will contribute 49% of the spawning stock biomass in 1995. More rapid rebuilding of spawning stock biomass will occur if this year class is protected. Rebuilding of spawning stock biomass over the long term is necessary to reduce the risk of recruitment failure.

Forecast Table for 1996-1997: F(1995)=0.18, Basis: Projected 1995 landings of 3,000 mt based on combined Canadian TAC and assumed USA landings. Recruitment of the 1994 year class was determined from research vessel survey recruitment indices. Predicted recruitment of the 1995 and 1996 year classes was estimated from the distribution of the observed 1979-1992 year class strength. SSB was estimated to be 14,600 mt in 1994 and 21,200 mt in 1995 (see Figure A4).

Median Landings and Spawning Stock Biomass
(thousands of mt)

Option	Basis	F_{1996}	Landings (95)	SSB (96)	Landings (96)	SSB (97)
A	Fishery Closed	0.00	3.1	26.8	0.0	33.0
B	F_{95}	0.18	3.1	25.8	4.1	28.2
C	F_{01}	0.24	3.1	25.5	5.4	26.7
D	$F_{30\%}$	0.35	3.1	24.9	7.4	24.3

Medium-Term Projections: Probability that SSB in 2004 exceeds 80,000 mt.

Option	F	Probability	Median Consequences/Implications
(A)	0.00	51%	SSB increases to 81k mt in 10 years and 120k mt in 20 years.
(B)	0.18	23%	SSB increases to 44k mt in 10 years and 50k mt in 20 years.
(C)	0.24	16%	SSB increases to 38k mt in 10 years and 44k mt in 20 years.
(D)	0.35	8%	SSB increases to 29k mt in 10 years and 30k mt in 20 year

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

Year	1988	1989	1990	1991	1992	1993	1994	1995	Max	Min (1963-1993)	Mean
USA Comm Landings	2.5	1.4	2.0	1.4	2.0	0.7	0.5[5]	-	52.9	0.7	13.7
Otter Trawl	2.4	1.4	1.9	1.3	2.0	0.7	n/a	-	52.0	0.7	13.4
Longline	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	n/a	-	1.1	<0.1	0.2
Other Gear	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	n/a	-	0.3	<0.1	0.1
CAN Comm Landings	4.0	3.1	3.3	5.4	4.1	3.7	2.4	-	18.3	0.5	5.4
Otter Trawl	3.2	2.0	2.4	4.0	2.6	2.5	1.6	-	17.9	0.4	4.9
Longline	0.7	1.0	0.9	1.3	1.4	1.1	0.7	-	1.4	<0.1	0.5
Other Gear	0.1	0.1	<0.1	0.1	0.1	0.1	0.1	-	0.3	<0.1	<0.1
Other Comm Landings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-	82.7	0.1	10.7[2]
Total Comm Landings	6.6	4.5	5.3	6.8	6.1	4.4	2.9	-	150.4	4.3	23.6
Discards	Discards occur but reliable estimates are not available							-	-	-	-
Catch used in Assessment	6.6	4.5	5.3	6.8	6.1	4.4	2.9	-	150.4	4.3	23.6
Sp. stock biomass[3]	17.6	18.1	19.5	17.4	12.5	10.0	14.6	21.2[1]	180.5	10.0	36.4
Recruitment (Age 1)	16.0	1.2	2.5	2.0	8.4	14.4	7.5	7.9	471.9	0.4	7.8[4]
Mean F (4-7,u)	0.37	0.30	0.36	0.45	0.54	0.53	0.29	0.18[1]	0.62	0.07	0.38
Exploitation Rate	28%	24%	28%	33%	38%	38%	23%	15%	42%	06%	29%

[1] Predicted or assumed.   [2] Over period 1962-1976   [3] At beginning of the spawning season, 1 April   [4] Geometric mean
[5] USA landings in 1994 were assumed

Stock Identification and Distribution: Georges Bank haddock are distributed primarily from the Northeast Peak to Nantucket Shoals, with minor occurrence in the Southern New England and Mid-Atlantic regions. Highest concentrations are currently found along the Northern Edge and Northeast Peak of Georges Bank. In earlier periods, significant concentrations were also located near the Great South Channel. Haddock are found at depths up to 150 fathoms.

Catches: Total commercial landings increased sharply in 1965 (150,000 mt) and 1966 (121,000 mt) as a result of increased exploitation by distant water fleets. Catches declined thereafter to less than 6,000 mt between 1972 and 1976, but increased in the late 1970s to 27,500 mt in 1980. Only USA and Canada have participated in this fishery since 1976. Total landings have since declined to an estimated low of 2,900 mt in 1994 (Figure A1). Estimates of USA landings in 1994 were unavailable and were assumed to be 500 mt. Landings by USA vessels are almost exclusively by otter trawl, while Canadian landings are taken by otter trawl and longline gear. Recreational landings from this stock have historically been negligible.

Data and Assessment: An analytical assessment (VPA) was conducted using 1963-1994 commercial landings-at-age data tuned with the ADAPT method with Canadian DFO spring and standardized NEFSC spring and autumn survey catch-per-tow at age data. The precision and uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1994 were quantitatively evaluated. The sensitivity of the assessment to the assumption of 1994 USA landings of 500 mt was evaluated by varying landings by 50% (i.e., 250, 500, 750 mt were evaluated). Estimates of F and SSB from these sensitivity analyses were virtually identical.

Biological Reference Points: Yield and SSB per recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1}$ = 0.24 (19% exploitation rate), and $F_{30\%}$ = 0.35 (27% exploitation rate) (Figure A3).

Fishing Mortality: During most of the 1980s, fishing mortality fluctuated between 0.3 and 0.4 (24-30% exploitation rate) but increased to about 0.54 (38% exploitation) in 1992 and 1993 before declining to 0.29 (23% exploitation) in 1994 (Figure A1). Accounting for the uncertainty associated with the 1994 F estimates, there is an 80% probability that the 1994 F lies between 0.24 (19% exploitation) and 0.39 (29% exploitation) (Figure A6).

Recruitment: Recruitment was poor from 1988 to 1991. The 1991, 1993, and 1994 year class strengths approximated the 1963-1993 mean. The 1992 year class was the best since 1987, about twice the 1963-1993 year class average (14.4 million fish at age 1 versus a mean of 7.8 million fish) (Figure A2).

Spawning Stock Biomass: SSB declined by 85% between 1978 and 1993 (68,900 mt to 10,000 mt), increased slightly in 1994 (Figure A2) and is expected to increase through 1997 due to the short term impact of the 1992 year class. Accounting for the uncertainty associated with the 1994 SSB estimates, there is an 80% probability that the 1994 SSB was between 12,500 mt and 18,500 mt (Figure A5).

Special Comments: In 1993 and 1994, management measures were implemented by Canada to reduce the capture of small haddock. These included a square codend mesh requirement and implementation of protocols to close fisheries if the percentage of small fish exceeds a given level. In 1994, the USA introduced a 500 pound trip limit for haddock, an extension and expansion of the closed area on the Northeast Peak and a 6" minimum codend mesh requirement. Several of these measures are likely to have resulted in a reduction in the proportion of age 2 fish taken in 1994.

Source of Information: Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments. 1995. NEFSC Ref. Doc. 95-18; O'Brien, L. and R. Brown. 1995. Assessment of the Georges Bank haddock stock for 1994. NEFSC Ref. Doc. 95-13.
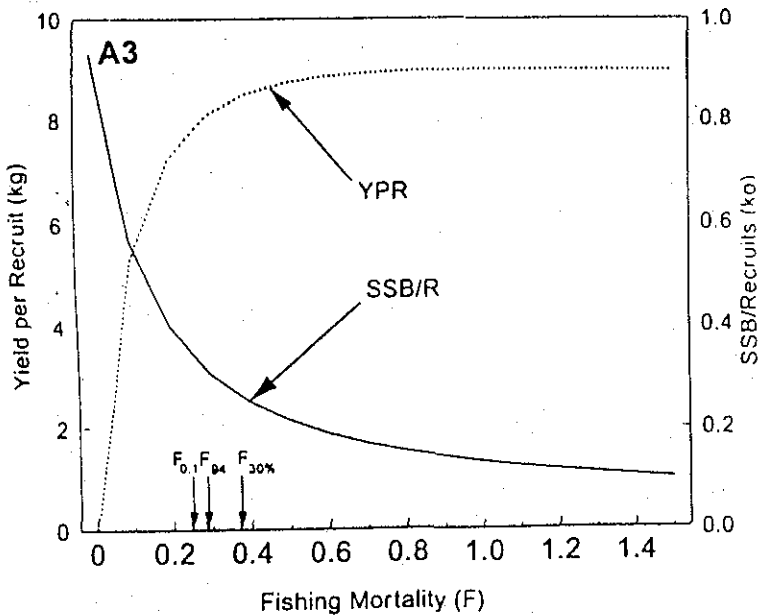
Georges Bank Haddock

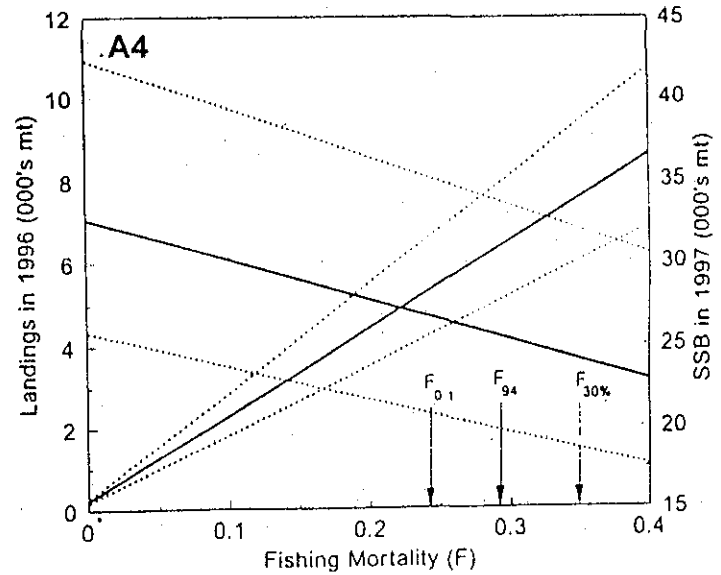**Trends in Commercial Landings and Fishing Mortality**
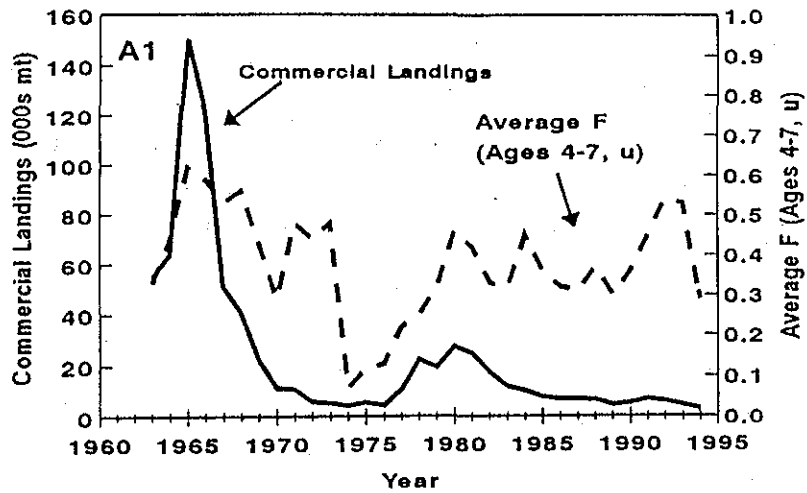
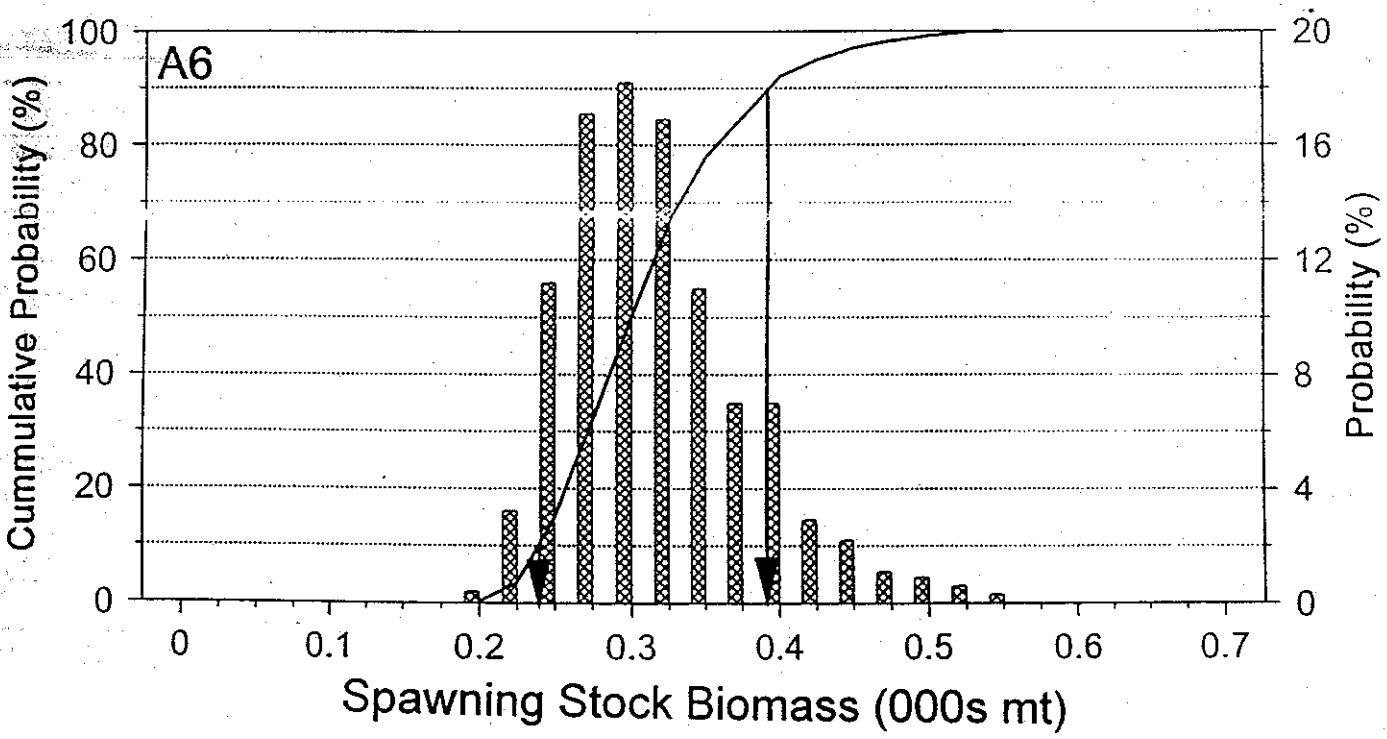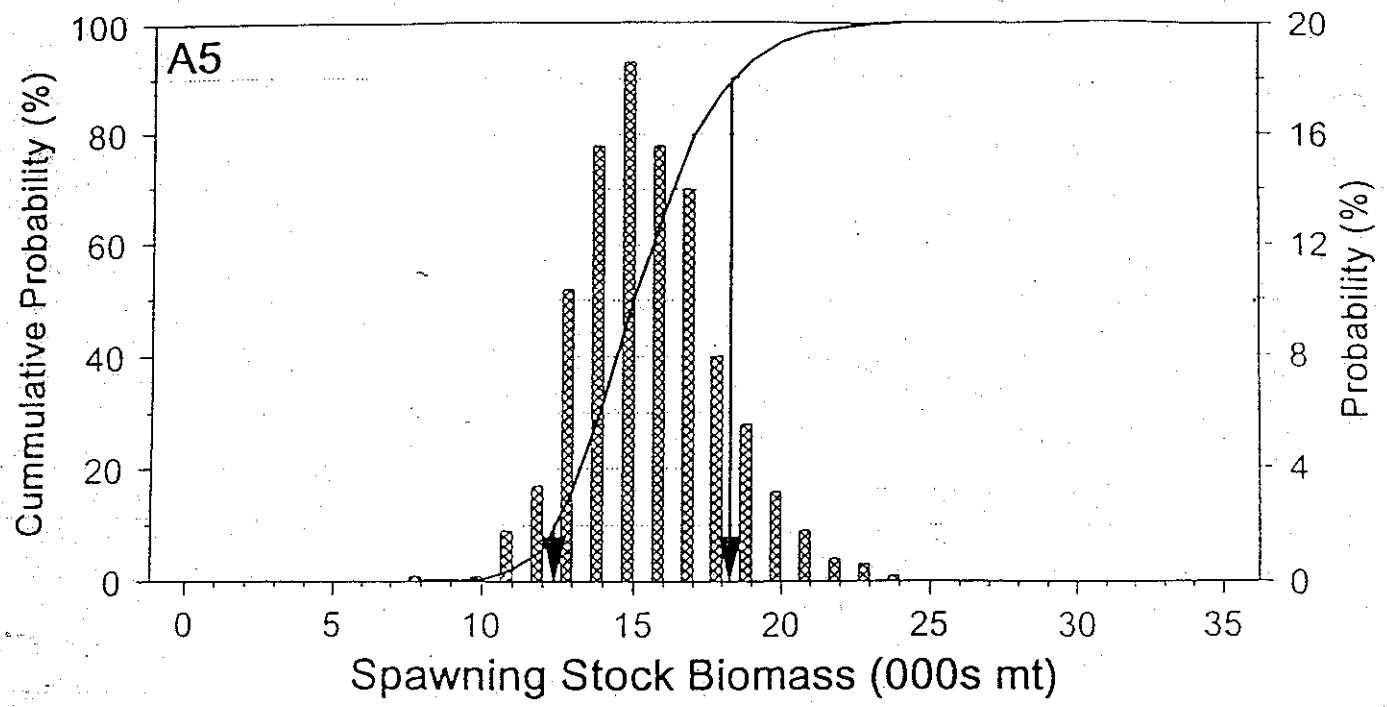**Trends in Spawning Stock Biomass and Recruitment**
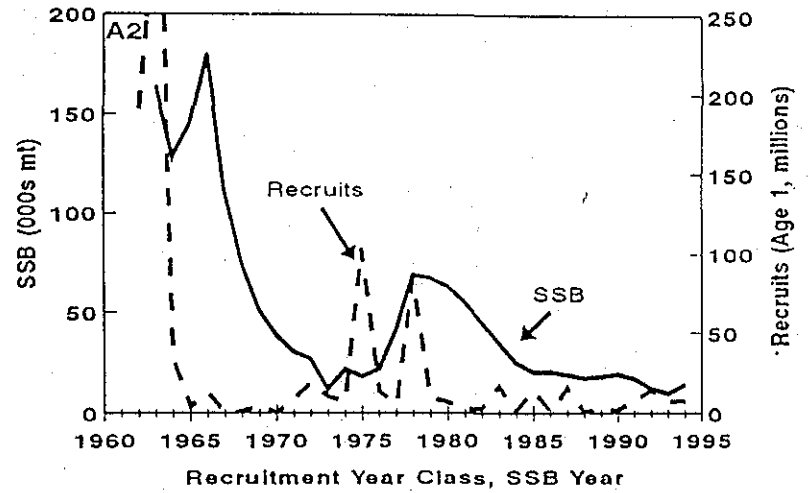
Yield and Spawning Stock Biomass per Recruit

Short-Term Landings and Spawning Stock Biomass
(Dotted lines indicate confidence intervals; upper - 90%, lower - 10%.)

Figures A5 and A6. Precision of the estimates of spawning stock biomass (A5) at the beginning of the spawning season (April 1) and instantaneous rate of fishing mortality (A6) on the fully recruited ages (ages 4+) in 1994 for Georges Bank haddock. The vertical bars display both the range of the estimator and the probability of individual values within the range. The solid line gives the probability of individual values within the range. The solid line gives the probability that F is greater than or SSB is less than the corresponding value on the X-axis. The solid arrows indicate the approximate 90% and 10% confidence levels for F and SSB. The precision estimates were derived from 500 bootstrap replications of the final ADAPT VPA formulation.
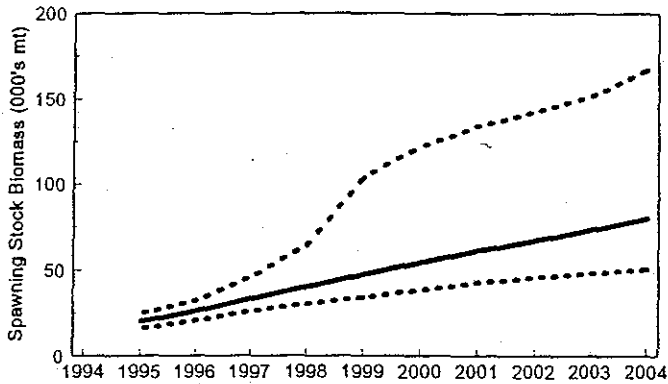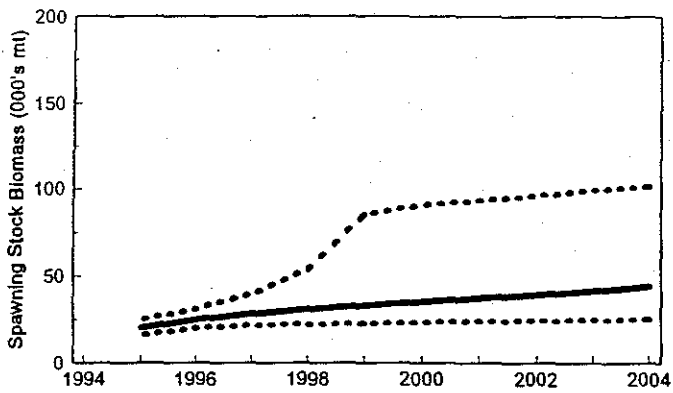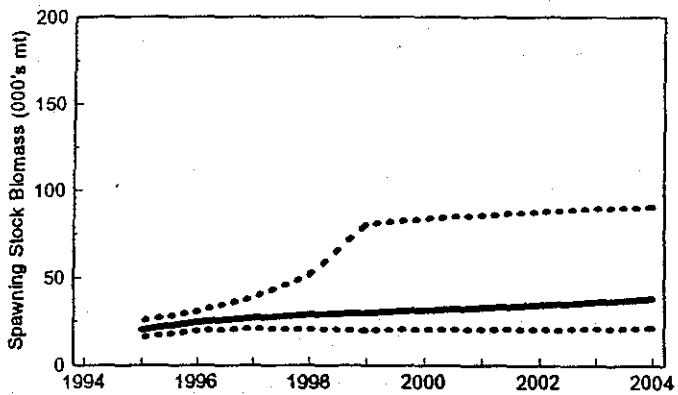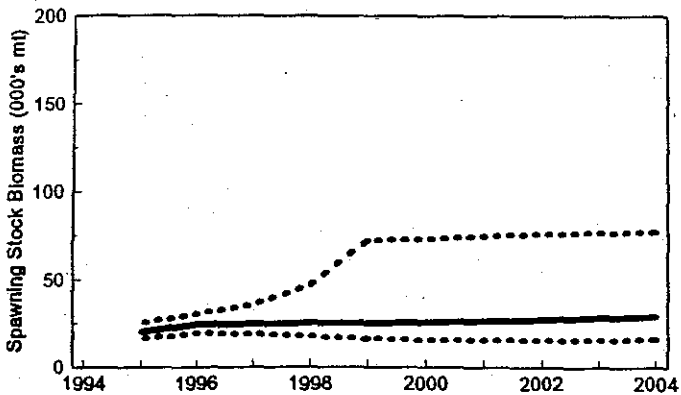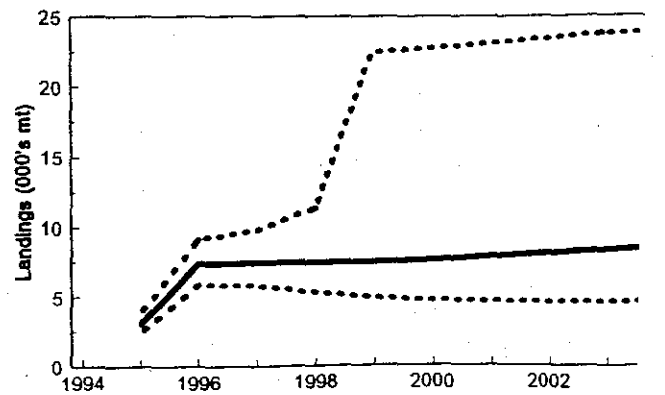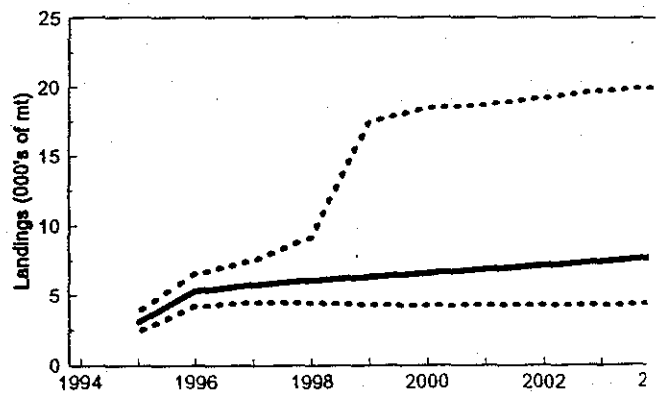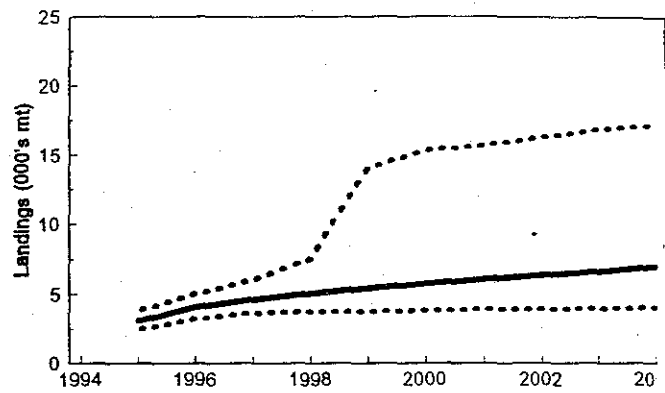
Figure A7. Results of medium-term (10 year) projections for Georges Bank haddock using fishing mortality scenarios of 0.0, 0.18, 0.24, and 0.35. Solid lines show median (50%) results, while dashed lines show 10% and 90% probabilities.

B. SUMMER FLOUNDER ADVISORY REPORT

State of Stock: The stock is at a medium level of historical abundance and is overexploited. The fishing mortality rate (F) on summer flounder was very high from 1988 to 1992 ranging between 1.2 (65% exploitation) and 1.9 (79% exploitation), peaking at 1.9 in 1988, but declined to 0.7 (46% exploitation) for 1994 (Figure B1). Fishing mortality in 1995 is expected to decrease to about 0.5 (36% exploitation) if the 1995 quota is landed and discards do not exceed 2,300 mt. Spawning stock biomass has increased from a record low in 1989 of 5,300 mt to 14,800 mt in 1994 (Figure B2), but the age structure of the spawning stock remains truncated (Figure B7). Recruitment has improved in recent years, and the 1994 year class is estimated to be slightly above average and larger than any since 1986 (Figure B2).

Management Advice: The presence of an above average 1994 year class affords the opportunity to more rapidly rebuild the spawning stock biomass, while allowing moderate catches. Reducing fishing mortality to the overfishing level (F_{max} = 0.23, 19% exploitation) would maximize yield per recruit and improve the spawning potential of the 1994 and subsequent year classes. The age structure of the spawning stock in 1995 remains truncated, with about 26% of the biomass at ages 3 and older (Figure B7). Under the present rebuilding schedule, about 60% of the spawning stock biomass is expected to be of ages 3 and older in 1998. Under equilibrium conditions at F_{max} at least 77% of the spawning stock biomass would be expected to be aged 3 and older (Figure B7).

Forecast for 1996-1998: A stochastic projection incorporating the uncertainty associated with the estimate of the 1995 stock size indicates that if the 1995 quota is landed (10,183 mt; commercial landings = 6,663 mt, recreational landings = 3,520 mt) and no dramatic increase in discarding occurs, fishing mortality in 1995 will be about 0.5, and meet the F_{tgt} = 0.53. If landings in 1996 are reduced to 6,640 mt and discards do not exceed 900 mt, there is a 50% probability that the F target for 1996 (F_{max} = 0.23) will be achieved, with a median spawning stock biomass level of 28,800 mt (Figures B4 and B8). In 1996, about 65% of the landings and 70% of the spawning stock biomass will be contributed by the 1994-1996 year classes. Under the rebuilding schedule defined by FMP Amendment 7 Option 5B, landings in 1996 would be 8,400 mt at an F of 0.30, and result in a median spawning stock biomass of 27,400 mt (Figures B8 and B9).

Forecast for 1996-1998

Forecast Medians (50% probability level)
(1995 landings are assumed as 10,200 mt, discards as 2,300 mt, and SSB as 20,100 mt)

	F_{95}	F_{96}	1996 '000 mt Land.	Disc.	SSB	F_{97}	1997 '000 mt Land.	Disc.	SSB	F_{98}	1998 '000 mt Land.	Disc	SSB
Amend. 7 Options													
1)	0.50	0.23	6.6	0.9	28.8	0.23	9.6	0.9	39.8	0.23	12.0	0.9	48.7
5A)	0.50	0.41	10.9	1.4	25.4	0.30	10.5	1.1	33.3	0.23	10.2	0.9	41.8
5B)	0.50	0.30	8.4	1.1	27.4	0.23	9.1	0.9	37.9	0.23	11.5	0.9	46.8

<u>Consequences/Implications</u>
<u>Amend. 7 Option 1 (status quo)</u> Landings decrease 35% to 6,600 mt in 1996, F target is met; SSB increases 43% over 1994 estimate. Landings in 1997 increase to 9,600 mt. Landings in 1998 increase to 12,000 mt.
<u>Amend. 7 Option 5A (constant harvest strategy)</u> Landings increase 7% to 10,900 mt in 1996; F_{96} = 0.41; SSB increases 26% over 1994. Landings decrease to 10,500 mt in 1997 and to 10,200 mt in 1998.
<u>Amend. 7 Option 5B (constant harvest strategy with 8,400 mt quota cap)</u> Landings decrease 18% to 8,400 mt in 1996 (F_{96} = 0.30); SSB increases 36% over 1994. Landings increase to 9,100 mt in 1997 (F = 0.23). Landings increase to 11,500 mt in 1998.

Summer Flounder

TRENDS IN TOTAL CATCH AND FISHING MORTALITY
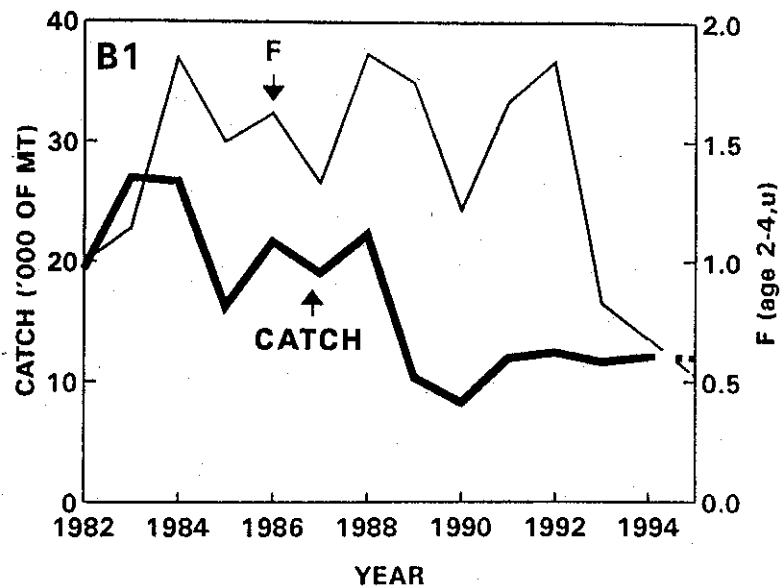
TRENDS IN SSB AND RECRUITMENT (R)
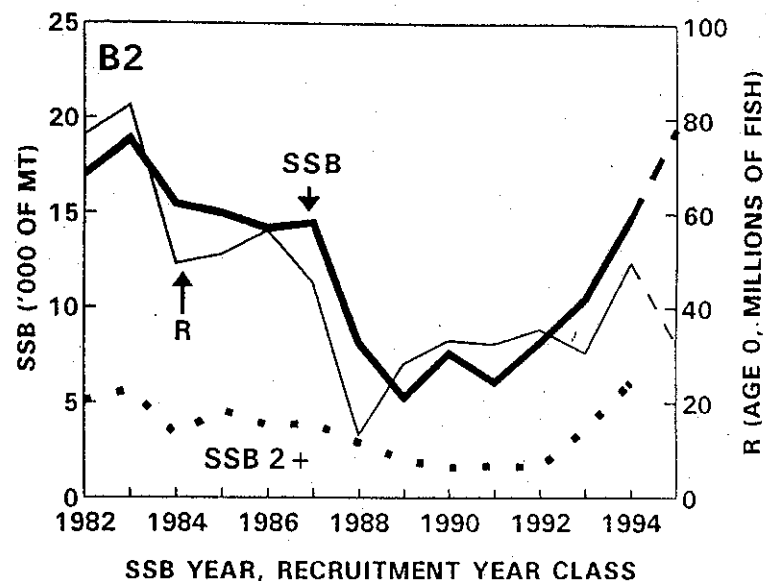
YIELD AND SPAWNING STOCK BIOMASS PER RECRUIT
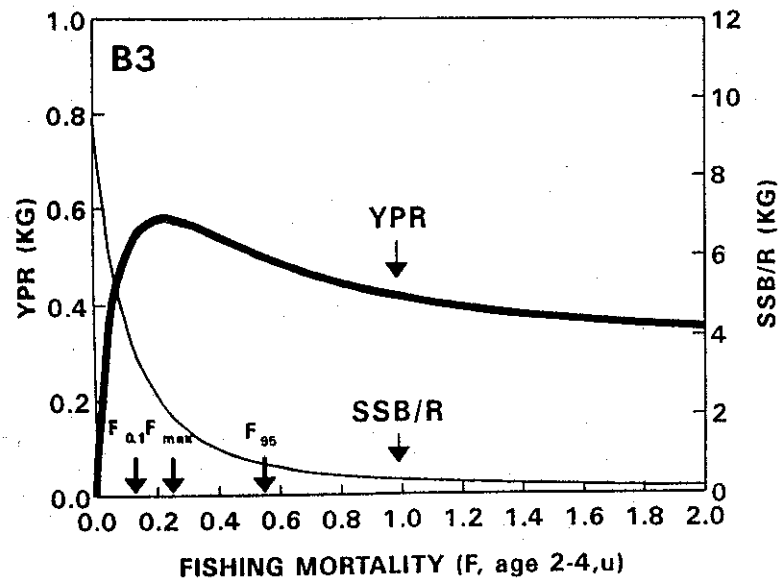

SHORT-TERM LANDINGS AND SPAWNING STOCK BIOMASS
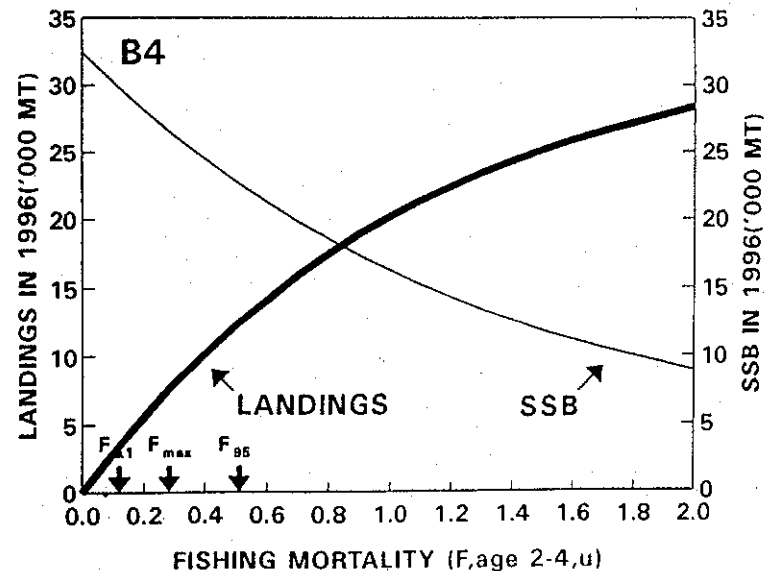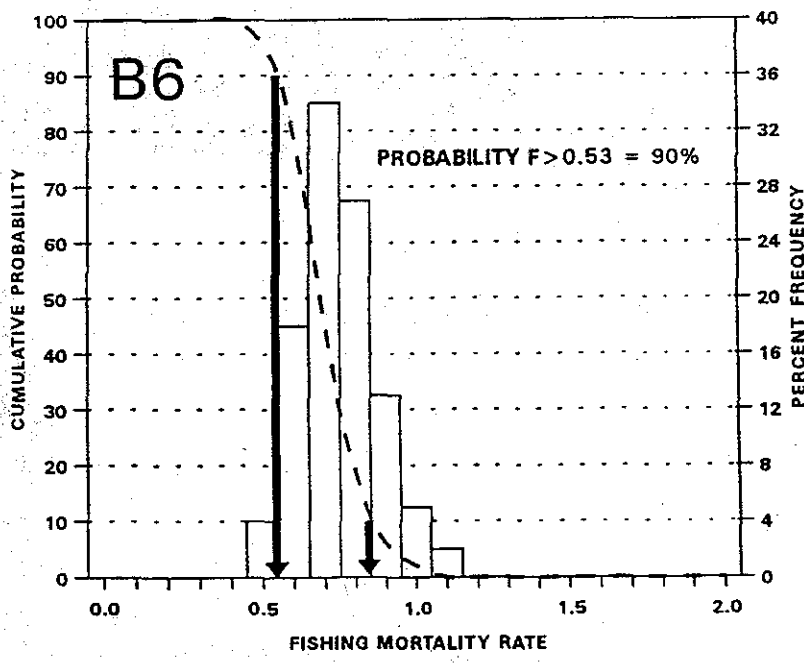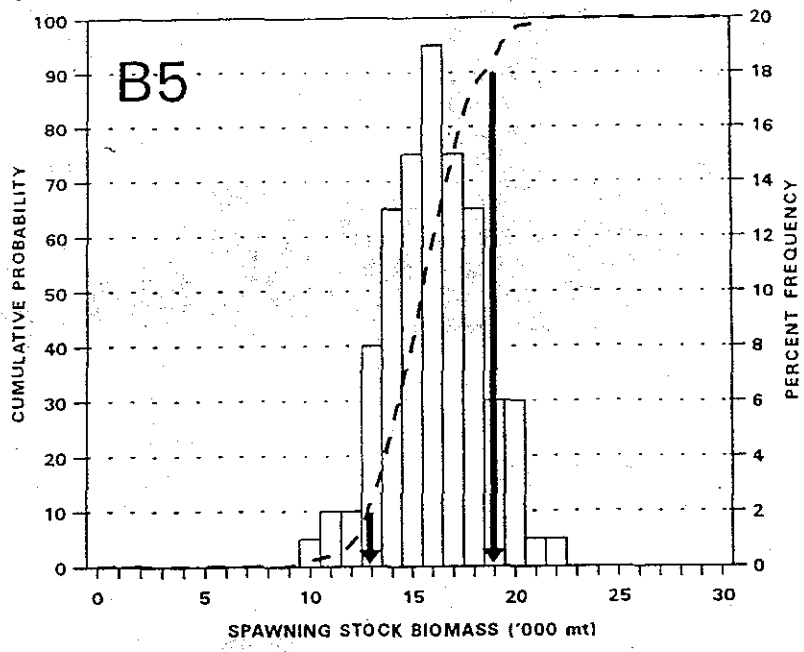
Figures B5 and B6. Precision of the estimates of spawning stock biomass at the beginning of the spawning season (B5), and fishing mortality, F (B6) on fully recruited ages (ages 2-4) in 1994, for summer flounder. The vertical bars indicate the probability of values within that range. The dashed line gives the probability that F is greater than or SSB is less than the corresponding value on the X-axis. The solid arrows indicate the approximate 90% and 10% confidence levels for F and SSB.
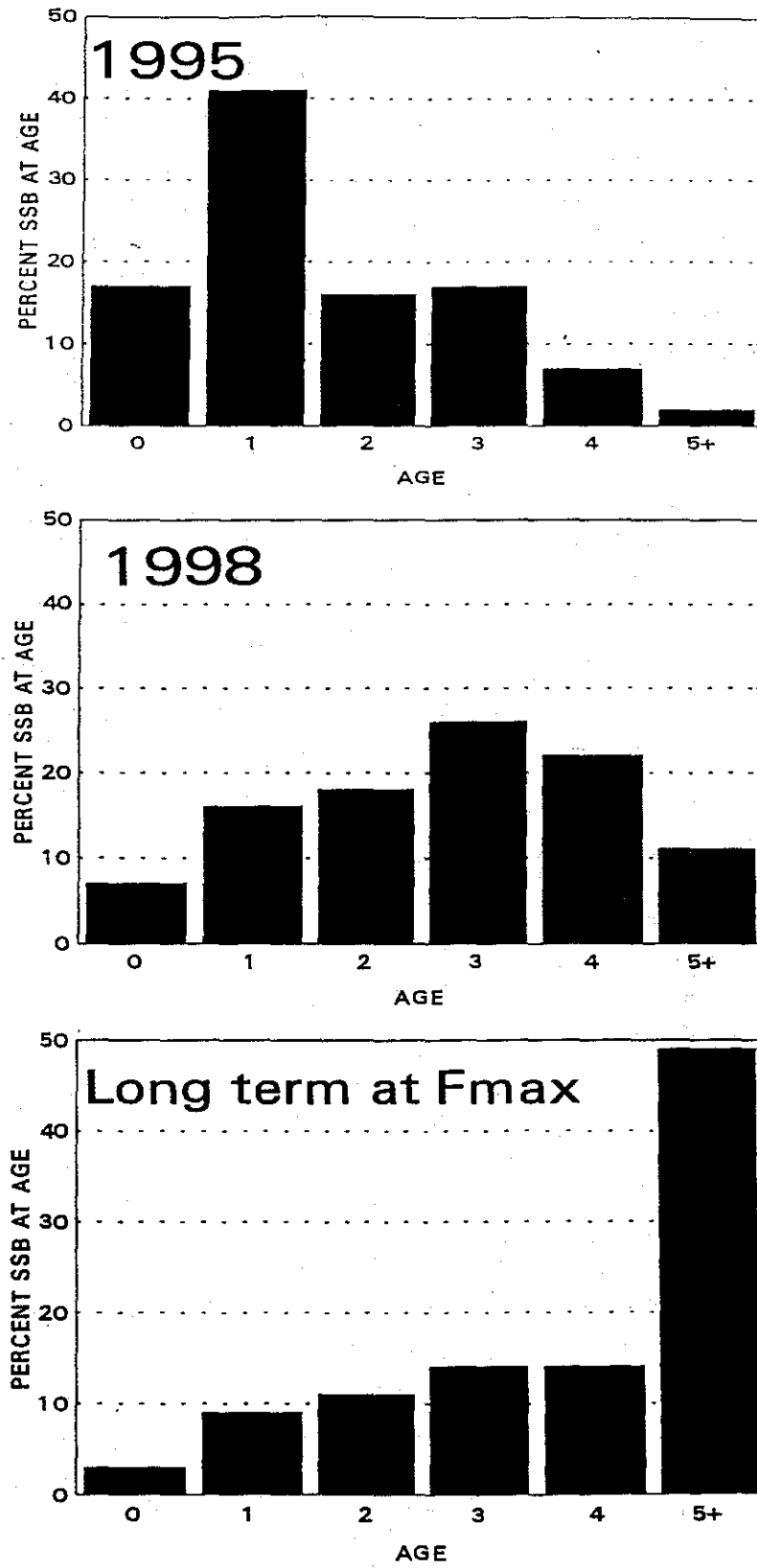
Figure B7.   Summer flounder percentage SSB at Age: Amendment 7 Option 1.
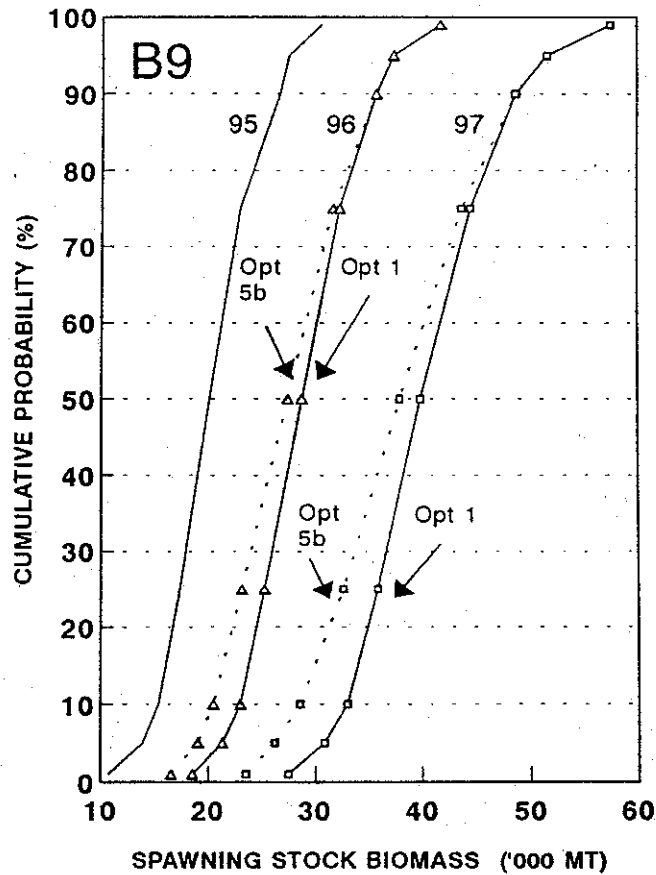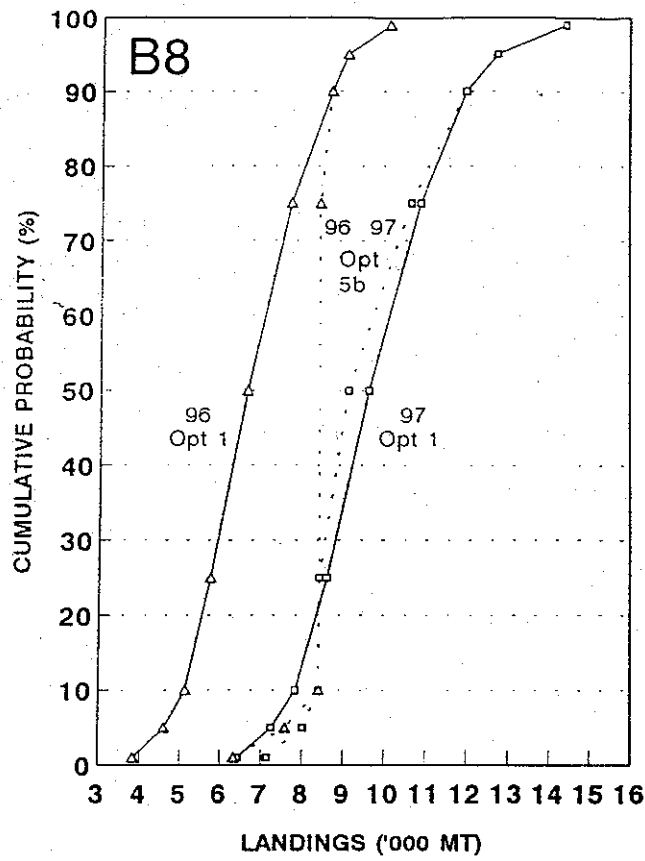
Figures B8 and B9. Cumulative probability distributions of summer flounder landings and SSB: Amendment 7 Options 1 and 5B.

C. ATLANTIC MACKEREL ADVISORY REPORT

State of Stock: The northwest Atlantic mackerel stock is at a high level of biomass and is under-exploited. Fishing mortality rate estimates have been below 0.05 (less than 4% exploitation rate) since 1990 (Figure C1). SSB is at a record-high level and has been above 1.0 million mt since 1985 (Figure C2). The stock has a broad heterogeneous age structure; age-3 and older mackerel comprised 51% of the total stock in 1994. Recent recruitment has been above average (Figure C2), but recruitment per unit of SSB has decreased due to density dependence. Landings in 1994 (23,600 mt) were the lowest since 1966, far below annual surplus production and the long-term potential yield for the stock (150,000 mt) (Figure C2).

Management Advice: Substantial amounts of yield (100,000 mt) are being foregone due to the extremely low level of exploitation on this stock. Increasing F to the MSY level (F=0.17) would also generate significant increases in yield per recruit without adversely affecting the reproductive potential of the stock.

Forecast for 1995: No forecasts were performed due to the imprecision of population estimates for 1994 and uncertainties about 1994 landings.

Catch and Status Table (Catch weights in '000 mt, SSB weights in '000 000 mt, recruitment in billions of fish): Atlantic Mackerel

Year	1987	1988	1989	1990	1991	1992	1993	1994 (Predicted)	Max	Min (1962-1993)	Mean
U.S.. Commercial Landings	12.3	12.3	14.6	31.3	27.0	11.8	4.7	10.1	31.3	0.9	59.1
Can. Commercial Landings	27.6	25.0	21.1	23.0	20.9	25.5	26.9	12.4	44.7	5.5	22.6
Other Commercial Landings	36.6	42.9	36.8	30.7	15.7	-	-	-	396.8	0.0	85.2
Commercial Discards[1]	-	-	-	-	-	-	-	-	-		-
Recreational Landings	4.0	3.3	1.9	1.9	2.4	0.3	0.5	1.1	16.0	0.3	3.4
Recreational Discards[1]	-	-	-	-	-	-	-	-	-	-	-
Catch used in Assessment	80.5	83.5	74.4	86.9	66.0	37.6	32.1	23.6	436.7	8.0	169.3
Spawning Stock Biomass	1.3	1.3	1.3	1.5	1.7	1.8	1.9	2.1	1.9	0.2	0.9
Recruitment (Age 1)	.5	1.5	1.9	.9	1.4	3.3	1.5	3.4	6.4	0.1	1.4
Mean F (Ages 4-11, w).05	.05	.07	.06	.04	.03	.02	.02	.02	.44	.02	.15
Exploitation Rate	5%	6%	5%	4%	3%	2%	2%	2%	33%	2%	13%

[1]Assumed to be minimal.

Stock Distribution and Identification: Atlantic mackerel in the northwest Atlantic comprise a single stock that ranges from North Carolina to Labrador. There are two primary spawning grounds: the Gulf of St. Lawrence and U.S. coastal waters from New Jersey to Long Island. There is no indication, however, that these spawning groups constitute genetically discrete populations with temporal and spatial integrity. This transboundary stock is highly migratory and its seasonal distribution patterns are thought to be influenced by oceanographic thermal regimes. In the spring the stock migrates northward in response to increased water temperature, while in the fall it migrates southward and offshore to avoid seasonal cooling of shelf waters.

Catches: Atlantic mackerel were heavily exploited by distant water fleets during the 1970s. Total landings in NAFO subareas 2-6 averaged 350,000 mt during 1970-1976, but this level was not sustained (Figure C1). Annual landings decreased to less than 50,000 mt during 1978-1984 and, since 1984, landings have remained below 40,000 mt. In recent years the majority of landings have come from Canadian waters. During 1992-1993, U.S. commercial and recreational landings totaled less than 10,000 mt; well below long-term historic yields.

Data and Assessment: Atlantic mackerel was last reviewed at the 12th SAW in 1991. The current assessment provides an update through 1994 using an analytical assessment (VPA) based on commercial and recreational catch-at-age data (landings) calibrated by NEFSC spring bottom trawl abundance indices. Uncertainty in stock size and fishing mortality estimates were characterized using bootstrapping methods.

Biological Reference Points: Fishing mortality-based biological reference points were derived from yield and spawning stock biomass per recruit analyses. Natural mortality (M) was assumed to be 0.20. A recruitment overfishing threshold ($50\%R_{Max.}$) and long-term potential yield were also calculated. Fishing mortality reference points were $F_{0.1} = 0.27$ and $F_{20\%} = 0.72$ (Figure C3). The 50% recruitment overfishing threshold was approximately 1 million mt of SSB. The long-term potential yield was estimated to be 150,000 mt with an associated SSB of 1 million mt. F_{MSY} was estimated as 0.17.

Fishing Mortality: During a period of high exploitation by distant water fleets prior to 1977, fishing mortality increased from 0.11 (9% exploitation rate) in 1965 to 0.44 (33% exploitation rate) in 1972 (Figure C1). F decreased during 1977-1991, averaging 0.06 (5% exploitation), and since 1991 has decreased further to less than 0.02 (2% exploitation). Accounting for the uncertainty associated with the 1994 estimate of F, there is an 80% probability that the 1994 F was between 0.004 and 0.032 (Figure C6), far below all biological reference points.

Recruitment: Recruitment during 1967-1974 was relatively high and averaged 2.1 billion fish at age 1 (Figure C2). Following the mid 1970s, recruitment fell sharply; between 1975 and 1985 recruitment was roughly 600 million fish at age 1. Since 1987 recruitment has increased to levels observed earlier in the time series; recruitment during 1991-1993 averaged 2.4 billion fish at age 1. In general, recruitment appears to decline when SSB falls below 1 million mt (Figure C4).

Spawning Stock Biomass: Spawning stock biomass (SSB) steadily increased between 1962 (191,000 mt) and 1972 (1.3 million mt) (Figure C2). SSB declined rapidly after 1972 to 498,000 mt in 1976 and remained near 500,000 mt until 1984 when the large 1982 year class began to mature. Spawning stock biomass subsequently increased during the mid-1980's and exceeded 1 million mt in 1985. Since 1985 SSB has remained above 1 million mt, has increased during the early 1990s, and has reached a record high in 1994 at 2.1 million mt. Accounting for the uncertainty associated with the 1994 SSB estimate, there is an 80% probability that the 1994 SSB was between 1.2 and 8.2 million mt (Figure C5).

Special Comments: Under current conditions of low catches and high stock biomass, an annual analytical stock assessment for mackerel is not needed. To increase the precision of this assessment, alternative survey approaches are needed. Such methods may include hydroacustic surveys, egg and larval survey analysis, and mid-water trawl surveys.

Source of Information: Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 95-18; Brodziak J. and W. Ling. 1995. An examination of the influence of environmental conditions on spring survey catches of Atlantic mackerel NEFSC Ref. Doc. 95-14; Brodziak J. and W. Overholtz. 1995. A comparison of some biological reference points for fisheries management. NEFSC Ref. Doc. 95-15.

Atlantic Mackerel

Trends in Commercial Landings and Fishing Mortality
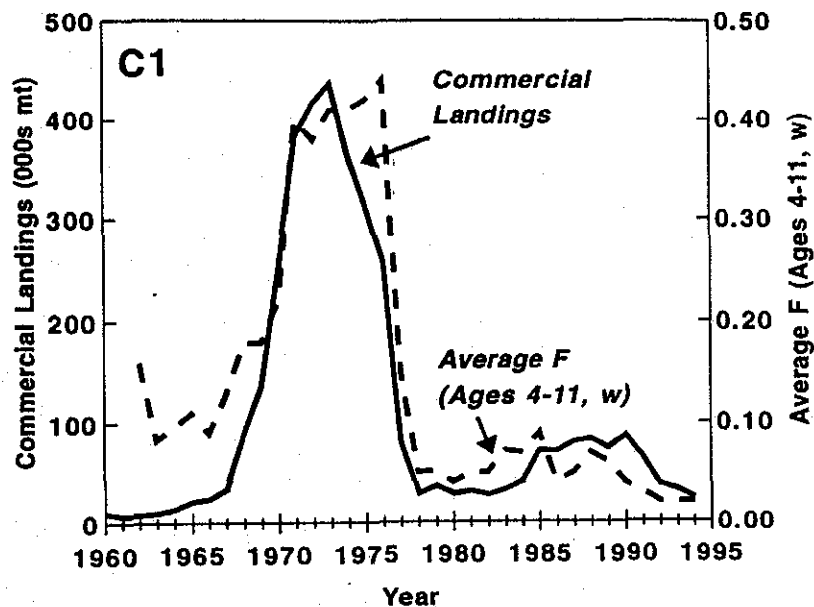
C1

Trends in Spawning Stock Biomass and Recruitment

C2

Yield and Spawning Stock Biomass

C3

Spawning Stock Biomass and Recruitment

C4
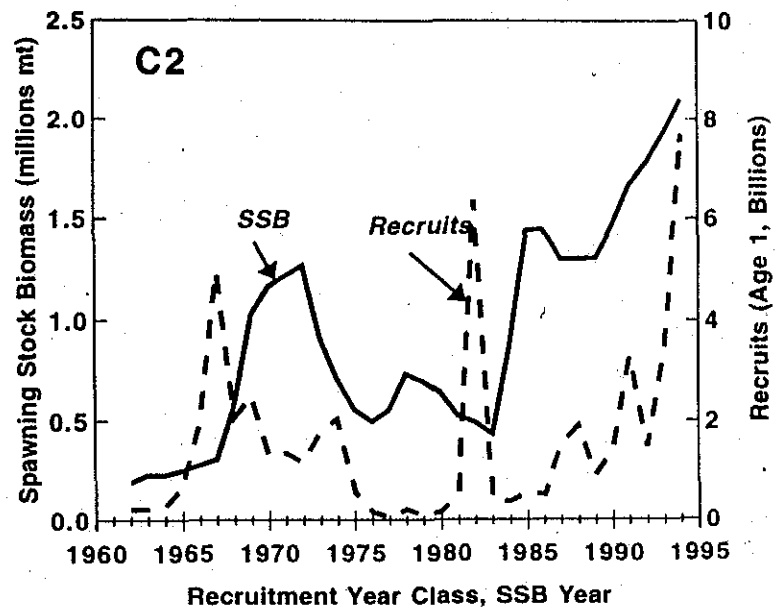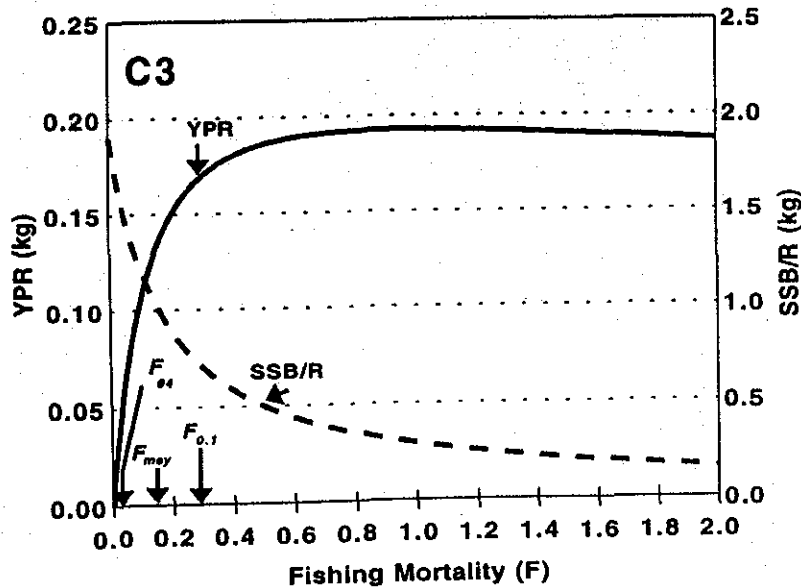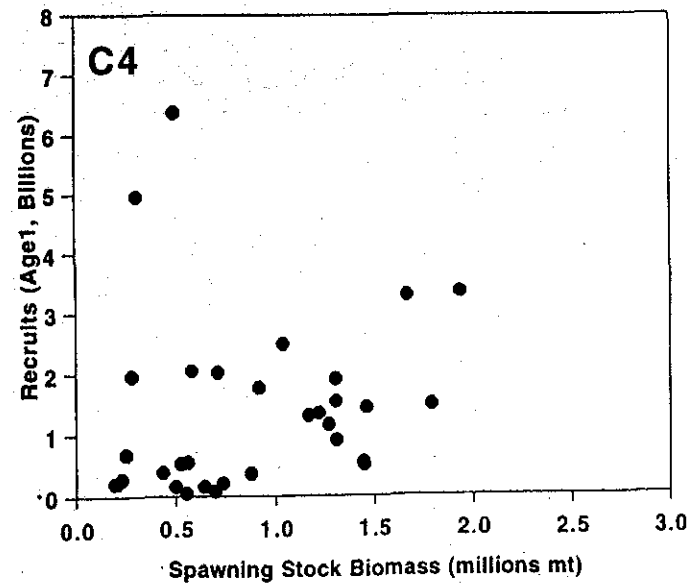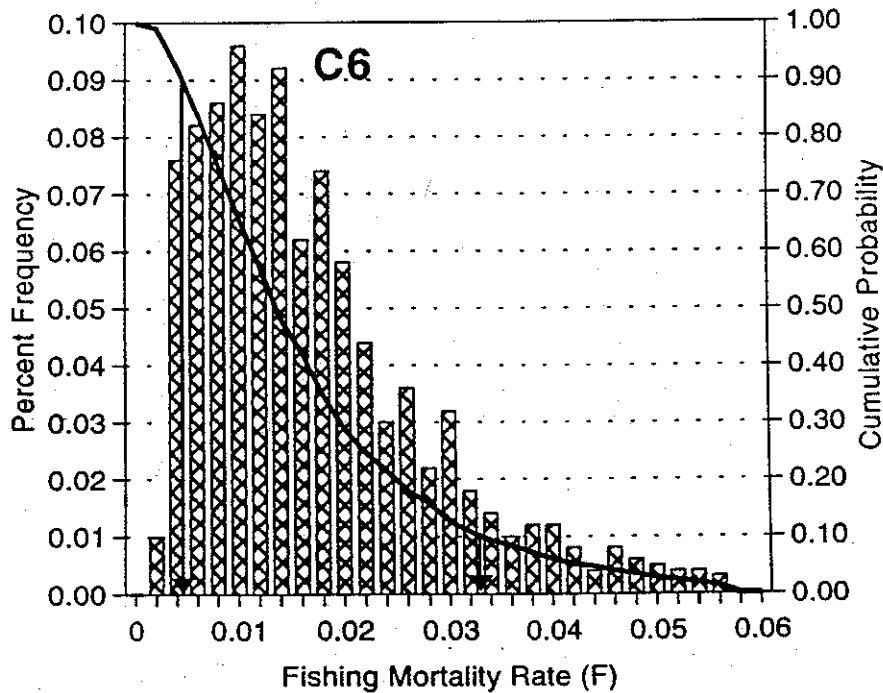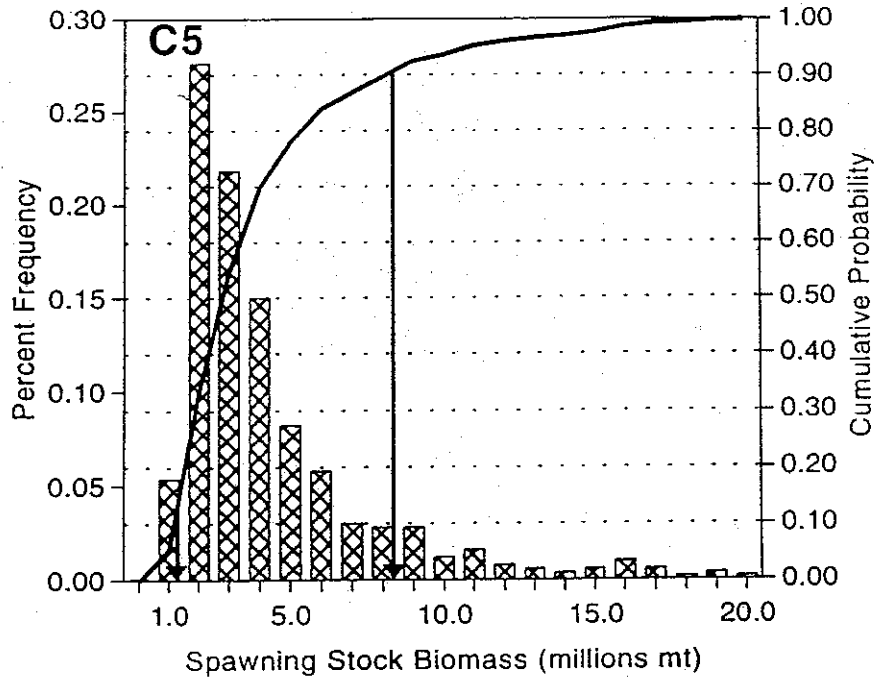
Atlantic Mackerel

Figures C5 and C6. Precision of the estimates of spawning stock biomass, SSB, (C5) and fishing mortality F (C6), for Atlantic mackerel. The bar height indicates the probability of values within the range. The dashed line gives the probability that the SSB is less than or F is greater than the corresponding value on the X-axis. The arrows indicate the approximate 90% and 10% confidence levels for SSB and F.

D. SEA SCALLOP ADVISORY REPORT

State of Stock: Overall stock abundance is low and the portion of the stock on the USA sector of Georges Bank is overexploited. Overall, the abundance of the fully-recruited stock reached a record low in 1993 (Figure D2). Fluctuations in catches are driven primarily by variations in the number of recruits entering the fishery. From 1990 to 1992 fishing mortality rates on the fully-recruited stock exceeded the overfishing definition in all resource areas except the Southeast Part of Georges Bank (Figure D4). Relative to the time series which begins in 1965, fishing effort on both the Mid-Atlantic and the US portion of Georges Bank remain at the maximum observed level, while landings per unit of effort (LPUE) in 1993 were the lowest observed (Figure D5).

Management Advice: Average 1992 fishing mortality rates for the overall resource (F=1.09) significantly exceeded the recruitment overfishing level ($F_{5\%}$=0.71). On an area basis, 1992 fishing mortality rates exceeded the overfishing definition in all areas except the New York Bight. In light of the high fishing mortality rates observed on the USA portion of Georges Bank, and poor recruitment in 1991 and 1992, fishing mortality should be reduced on this portion of the stock as quickly as possible. Catches in the Mid-Atlantic are dependent on the strength of incoming year classes. Abundance and catch are expected to decline unless recruitment improves.

Forecast for 1995: No forecasts were performed.

Landings and Status Table (weights in mt, abundance in millions): Sea Scallop

Year	Stock[a]	1982	1983	1984	1985	1986	1987	1988	1989
Landings	Georges Bank	6509	4328	3071	2949	4511	4885	6083	5686
(mt)	Mid-Atlantic	1702	3227	3825	3291	3756	7892	6521	8309
	Other[b]	833	1152	843	502	394	450	594	781
	USA Total	9044	8707	7739	6742	8661	13227	13198	14776
Recruits	Georges Bank	365	158	158	172	372	340	305	292
(millions)	Mid-Atlantic	121	136	101	449	584	564	518	781
Areas combined		486	294	258	621	956	904	823	1073
Full	Georges Bank	275	275	230	240	259	367	351	324
Recruits	Mid-Atlantic	271	290	327	321	624	843	981	949
(millions)	Total	547	565	557	561	883	1210	1332	1273
Exploitable	Georges Bank	5,047	4,796	3,453	3,938	5,235	5,149	4,894	5,533
Biomass	Mid-Atlantic	2,731	3,409	3,955	4,262	8,077	10,887	10,695	11,282
(mt)	Areas combined	7,778	8,205	7,408	8,200	13,312	16,036	15,589	16,815
Fully-Rec	Georges Bank	1.04	0.66	0.47	0.46	0.63	0.79	0.79	0.57
Fishing	Mid-Atlantic	0.24	0.19	0.21	0.16	0.34	0.33	0.43	0.65
Mortality	Total	0.66	0.40	0.32	0.26	0.43	0.46	0.53	0.63

						Min	Max	Mean
Year	Stock[a]	1990	1991	1992	1993		(1982-1993)	
Landings	Georges Bank	10009	9311	8237	3655	2949	10009	5770
(mt)	Mid-Atlantic	6475	7011	4955	2778	1702	8309	4979
	Other[b]	690	676	846	863	394	1152	719
	USA Total	17174	16998	14038	7296	6742	17174	10748
Recruits	Georges Bank	566	685	410	125	125	685	329
(millions)	Mid-Atlantic	903	329	151	760	101	903	450
	Total	1469	1014	561	885	258	1467	779
Full	Georges Bank	360	298	387	208	208	387	298
Recruits	Mid-Atlantic	949	749	474	330	271	981	592
(millions)	Total	1310	1047	862	538	538	1332	890
Exploitable	Georges Bank	4,597	4,335	4,616	3,424	3,424	5,533	4,585
Biomass	Mid-Atlantic	6,589	7,935	4,559	4,176	2,731	11,282	6,546
(mt)	Areas combined	11,186	12,270	9,175	7,600	7,408	16,815	11,131
Fully-Rec	Georges Bank	1.49	1.28	1.67	N/A	0.46	1.67	0.90
Fishing	Mid-Atlantic	1.07	0.85	0.61	N/A	0.16	1.07	0.46
Mortality	Total	1.19	1.02	1.09	N/A	0.26	1.19	0.64

a) Georges Bank, Mid-Atlantic, and Other (Gulf of Maine, Southern New England, and Miscellaneous NAFO Areas 5 and 6.
b) No stock assessment has been done in these areas.

Stock Distribution and Identification: Sea scallops range from North Carolina to Newfoundland along the continental shelf of North America. In USA waters, the population is predominately in the Mid-Atlantic and Georges Bank regions. Overall abundance in Southern New England and the Gulf of Maine is much lower. For management purposes, sea scallops are treated as a unit stock.

Catches: Since 1982, USA catches have ranged between 6,700 (1985) and 17,000 mt (1990) (Figure D1). USA catches in 1993 of 7,300 mt were the lowest since 1985 and represented a decrease of 48% from 1992. On Georges Bank, 1993 catches (3,700 mt) decreased by 56% from 1992 levels. In the Mid Atlantic region, 1993 catches (2,800 mt) were 44% lower than in 1992. Historically, over 95% of landings have been taken by scallop dredges. Since 1985 however, the fraction of landings taken in otter trawls in the Mid Atlantic region has increased from 1% to 14%.

Data and Assessment: Sea scallops were last assessed in 1992 (SAW-14). The current assessment of the Mid-Atlantic and USA Georges Bank resources are analytical assessments (modified DeLury model) based on commercial landings, LPUE, and NEFSC research vessel survey data adjusted for size selective catchability. The natural mortality rate was assumed to be 0.10.

Biological Reference Points: Yield per recruit analyses based on an exploitation pattern using a 3-1/4 ring size in scallop dredges indicated that $F_{0.1} = 0.10$ and $F_{max} = 0.18$.

Fishing Mortality: Fishing mortality rates, both in the Mid-Atlantic region and in the USA sector of Georges Bank, increased markedly between 1985 and 1990, and exceeded 1.0 (61% exploitation rate) in 1990. During 1991 and 1992, fishing mortality remained very high on Georges Bank averaging 1.48 (75% exploitation rate) but declined in the Mid-Atlantic to F=0.61 (43% exploitation rate). In both regions, fishing mortality is far in excess of F_{max} and F greatly exceeds the overfishing definition ($F_{5\%}$ = 0.71) on Georges Bank. Accounting for the uncertainty associated with the 1992 F estimates in each of the sea scallop resource ares in the Mid-Atlantic and on Georges Bank there is a 75% probability that the 1992 Fs in all areas except the New York Bight exceeded the overfishing definition.

Recruitment: In the DeLury model, recruits are defined as the number of scallops that will enter the fishery in the current year. In 1993, recruitment on Georges Bank was the lowest on record; in the Mid-Atlantic, the number of recruits was among the highest on record and five times greater than in 1992 (Figure D2). The absence of strong year classes on Georges Bank in recent years has resulted in a continuing overall decline in landings and abundance.

Stock Biomass: Spawning stock biomass was not computed for this assessment. Biomass for the fully recruited portion of the overall stock (exploitable biomass) has declined since 1988 (Figure D2). Exploitable biomass for the Georges Bank portion of the stock has declined to a record low relative to a time series beginning in 1982. Exploitable biomass of the Mid-Atlantic portion of the resource has also declined and in 1993, is estimated as below the 1982-1993 average for this portion of the stock.

Special Comments: Increased sampling of landings from otter trawl vessels is required to ensure reliable estimation of catch numbers in the Mid-Atlantic region. More generally, the overfishing definition should be re-evaluated to better account for potential biological differences between the Georges Bank and Mid-Atlantic portions of the stock and to address recent changes in fisheries regulations.

Sources of Information: Report of the 20th Stock Assessment Workshop (20th SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 95-18; Wigley, S. and F.Serchuk. 1995. Current resource conditions in Georges Bank and Mid-Atlantic sea scallop populations: Results of the 1994 NEFSC sea scallop research vessel survey, NEFSC Ref Doc 96-03; Lai, H.-L., L. Hendrickson, S. Wigley. 1995. Status of sea scallop fisheries off the Northeastern United States, 1993, NEFSC Ref. Doc. 95-16; Robert, G.G., et al. 1994. Georges Bank Scallop Stock Assessment--1993. Dept Fisheries and Oceans Atlantic Fisheries, Research Doc 94/97.

Sea Scallop

D1
Landings and Fishing Mortality
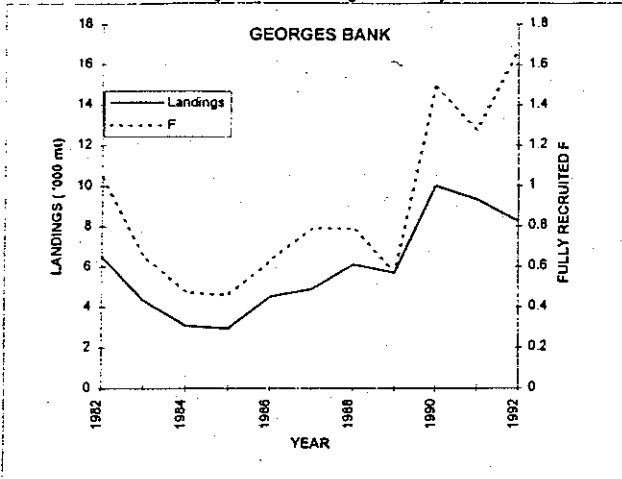
GEORGES BANK

MID-ATLANTIC

GEORGES BANK & MID-ATLANTIC

D2
Stock Size in Number
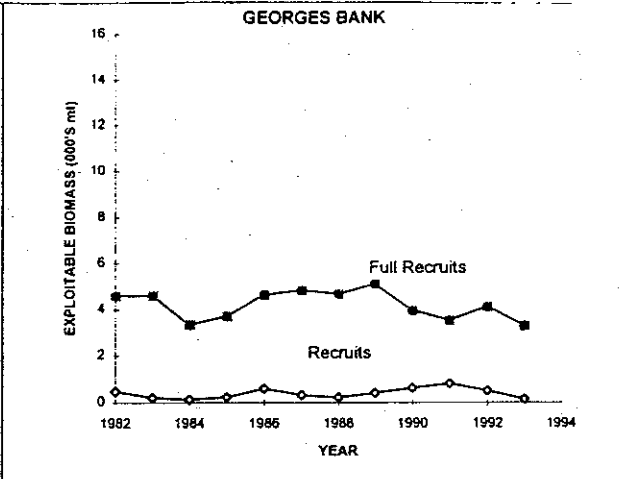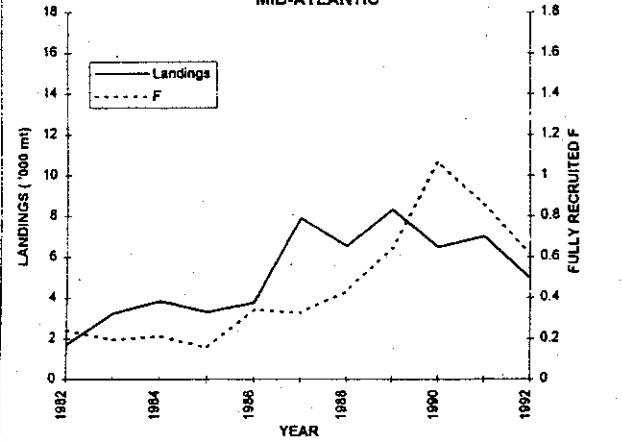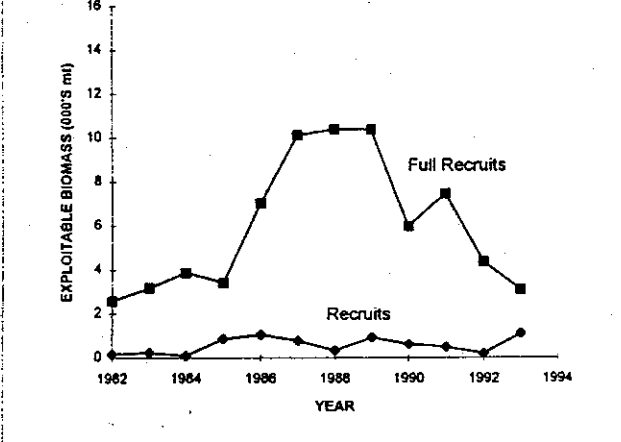
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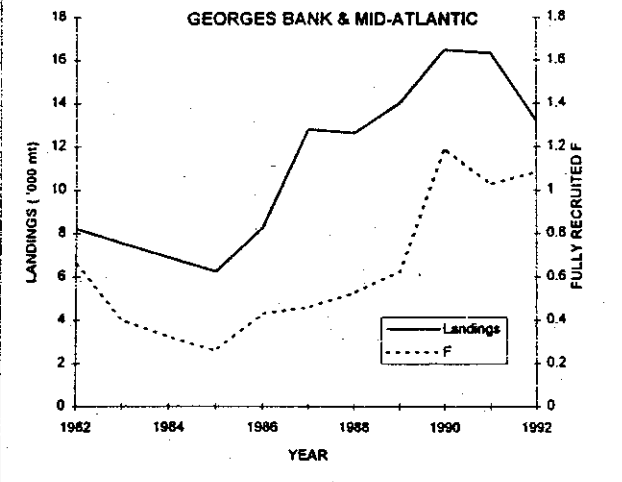
MID ATLANTIC

GEORGES BANK & MID-ATLANTIC
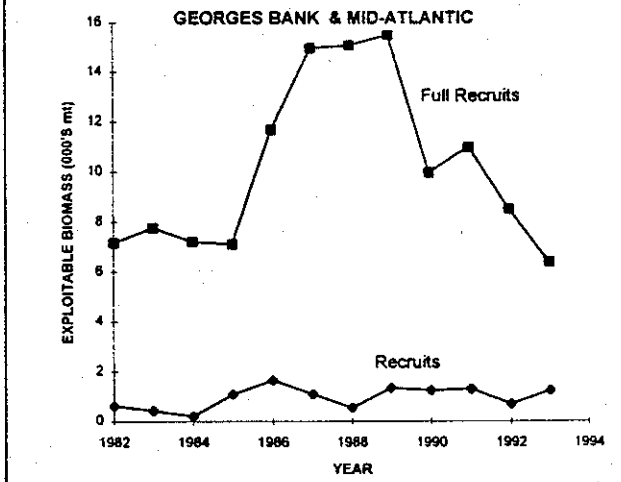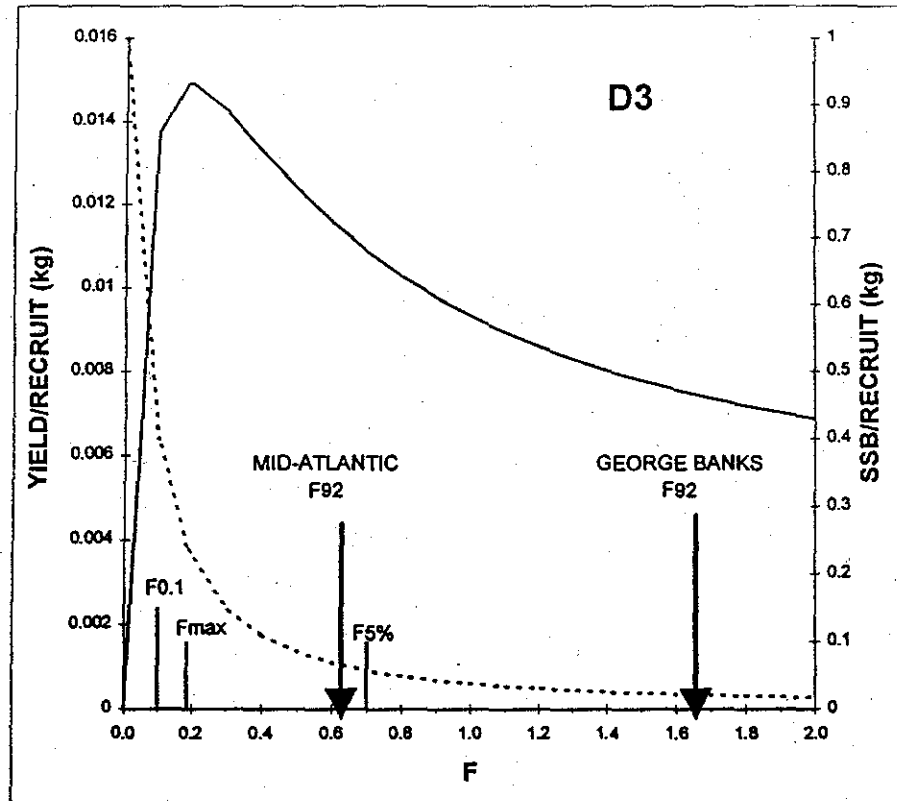
Sea Scallop

Estimations of Y/R and SSB/R are obtained from Sea Scallop FMP Amendment 4. Selectivity pattern based on 3-1/4 inch rings. Partial recruitment is 0.26 at age 3 and 1.0 thereafter.

Sea Scallop
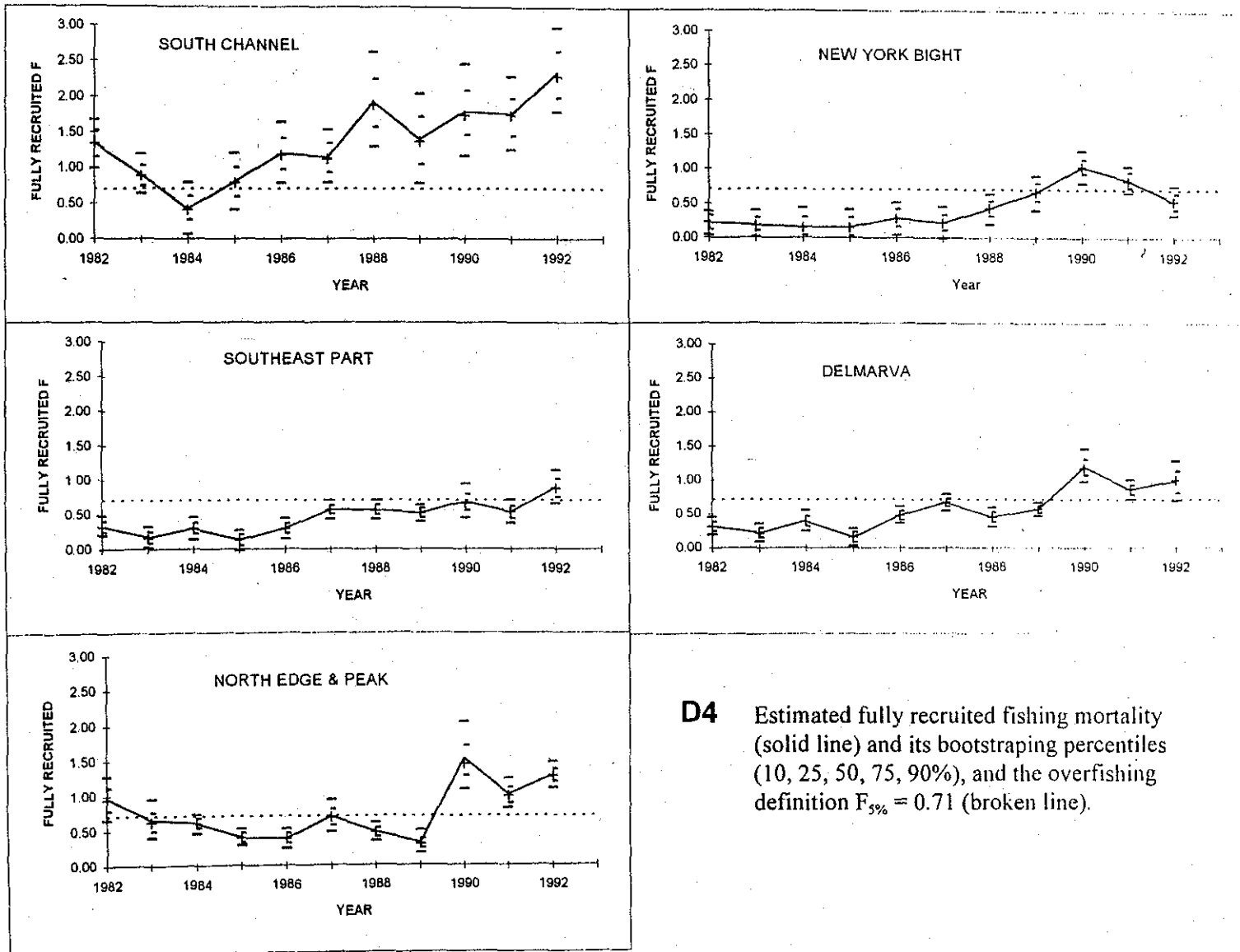
D4 Estimated fully recruited fishing mortality (solid line) and its bootstraping percentiles (10, 25, 50, 75, 90%), and the overfishing definition $F_{5\%} = 0.71$ (broken line).

Sea Scallop
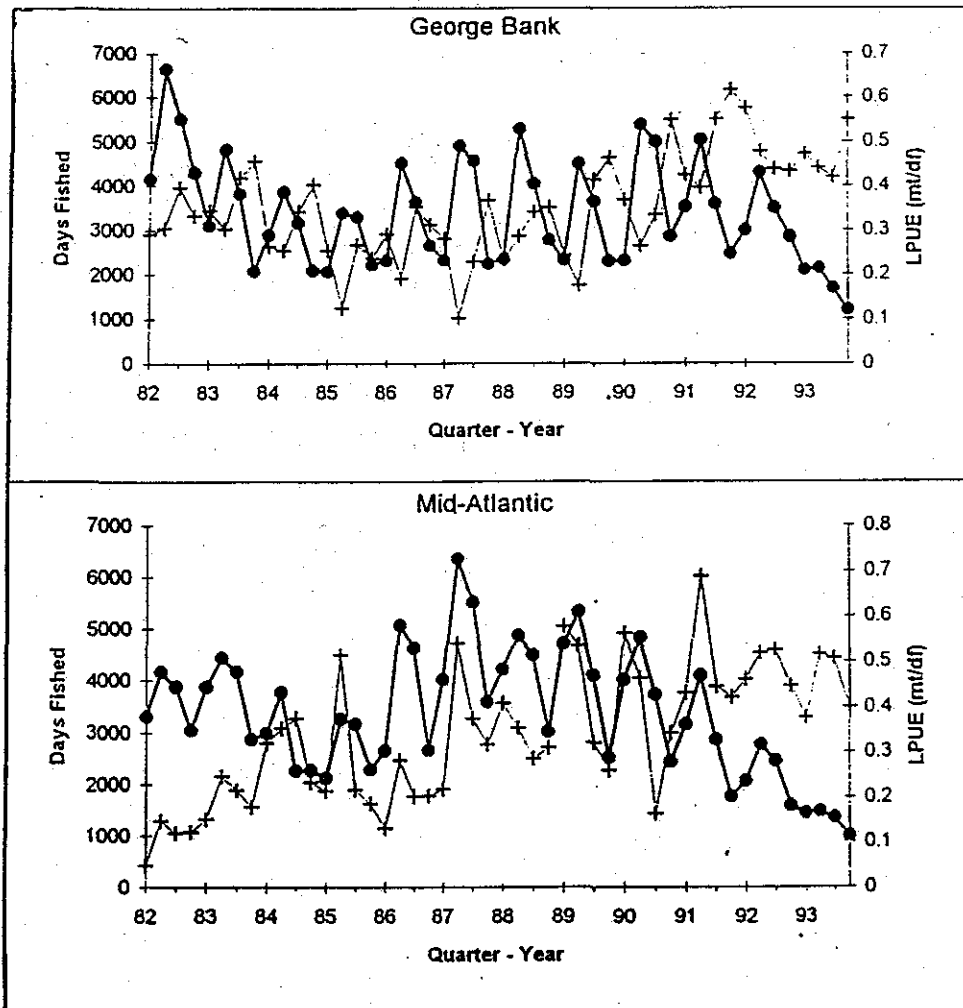
D5 Effort (Days Fished, df) and landing per unit effort (LPUE) in Georges Bank and the Mid-Atlantic regions, 1982-1993. (Solid circles: LPUE, +: Days Fished).

E. BLACK SEA BASS ADVISORY REPORT

State of Stock: The stock is overexploited and at a medium biomass level. Estimated fishing mortality rates (1984-1993) have been well above F_{max} (0.29) and were near 1.7 (76% exploitation rate) in 1991-1993. Spawning stock biomass declined by 50% between 1986 and 1991 and reached a record low in 1991. Recruitment in 1993 and 1994 was the lowest on record, and the stock has a highly truncated age structure (only 4.5% of the stock in 1993 was older than age 3).

Management Advice: Fishing mortality on fully-recruited fish has been far in excess of biological reference points and should be substantially reduced as soon as possible. Current record low recruitment, if continued, could result in a collapse of the fishery. The extremely truncated age structure of black sea bass could result in a shortage of males in the population, resulting in a disruption of reproduction. Higher size limits in combination with effort reduction will generate significant increases in yield and a greater proportion of breeding animals.

Forecast for 1995: A quantitative forecast of catch and SSB for 1995 is not provided because of the high degree of uncertainty in the current estimates of fishing mortality and stock size.

Catch and Status Table (weights in '000 mt, recruitment in millions of fish): Black Sea Bass

Year	1988	1989	1990	1991	1992	1993	1994	1995	Max	Min	Mean
										(1984-1993)	
Commercial Landings	1.9	1.3	1.6	1.3	1.4	1.4	-	-	2.0	1.3	1.6
Commercial Discards[1]	0.1[2]	0.1	0.1	0.1	0.1	0.1	-	-	0.2	0.1	0.1
Recreational Landing	1.2	1.5	1.3	1.9	1.2	2.0	1.3	-	5.6	0.1	1.7
Recreational Discards[3]	0.1	0.1	0.1	0.1	0.2	0.1	0.1	-	0.2	<0.1	0.1
Catch used in Assessment	3.4	3.0	3.1	3.4	2.9	3.6	-	-	7.8	2.8	3.6
Spawning Stock Biomass[4]	2.7	3.0	2.7	2.2	2.4	3.1	-	-	4.7	2.2	3.0
Recruitment (Age 1)	20.2	10.6	19.2	19.4	20.7	2.5	1.6	-	39.0	2.5	18.6
Mean F (Ages 3-5, u)	1.45	1.09	1.13	2.03	1.89	1.05	-	-	2.03	1.05	1.39
Exploitation Rate	71%	61%	62%	81%	79%	60%	-	-	81%	60%	70%

[1]Assuming 100% mortality (trawl) and 50% mortality (pots) [2] Extrapolated values. [3]Assuming 25% mortality. [4]At start of spawning, June 1.

Stock Distribution and Identification: Stock identification studies indicate that two stocks of black sea bass occur off the Northeastern Coast of the United States: one south of Cape Hatteras and one north of Cape Hatteras. The northern stock is distributed primarily between Cape Cod, MA and Cape Hatteras, NC, and was the subject of this assessment.

Catches: Annual commercial landings fluctuated around 2,600 prior to 1948, increased to a peak of 9,900 mt in 1952, but then fell to only about 1,000 mt in the early 1970s. Commercial landings increased moderately during 1975-1979, varying between 1,700 and 2,400 mt per year and have since remained relatively stable, ranging between 1,400 and 1,600 mt during 1989-1993. Recreational landings have varied between 560 and 5,600 mt per year; since 1988 recreational landings have fluctuated between 1,200 and 2,000 mt. Commercial discard mortality, estimated from sea sampling data, averaged 120 mt per year during 1989-1993; the 1993 estimate was 69 mt. Recreational discard mortality averaged 105 mt annually during 1984-1993. Total catch during 1984-1993 ranged from a high of nearly 8,000 mt in 1986 to a low of 2,800 mt in 1985 (Figure E1).

Data and Assessment: Black sea bass was last assessed at the 11th SAW in 1990 based on survey abundance indices and length-based mortality analyses. The current assessment is analytical (VPA using ADAPT) and based on commercial and recreational catch-at-age data (landings and discards) for 1984-1993. Commercial discards during 1984-1988 and in the second half of 1992 were extrapolated from 1989-1991 and 1993 data. Natural mortality (M) was assumed to be 0.20. Information on recruitment and stock abundance was derived from NEFSC spring trawl survey catch-per-tow data.

Biological Reference Points: Yield per recruit analyses based on an exploitation pattern derived from the VPA analysis indicated that $F_{0.1} = 0.18$ (15% exploitation) and $F_{max} = 0.29$ (23% exploitation) (Figure E3).

Fishing Mortality: Fishing mortality has been very high during the past ten years, ranging between 1.05 in 1993 (60% exploitation) and 2.03 in 1991 (81% exploitation) and averaging 1.39 (70% exploitation) (Figure E1), far in excess of any biological reference points. Accounting for the uncertainty in the 1993 estimates of F, there is an 80% probability that the 1993 F estimate of 1.05 was between 0.70 (46% exploitation rate) and 1.55 (73% exploitation rate) (Figure E6).

Recruitment: Recruitment has generally declined during past years from a peak of 39 million fish at age 1 in 1985 to a record low 1.6 million fish in 1994 (Figure E2). The 1992 and 1993 year classes are the smallest in the series.

Spawning Stock Biomass: SSB declined by about 50% from 1986 to 1991, but increased in 1992 and 1993 due to recruitment of the above average 1990 and 1991 year classes (Figure E2). Accounting for the uncertainty in the 1993 stock size estimates, there is an 80% probability that the SSB in 1993 was between 2,400 and 4,700 mt (Figure E5). A 81% decline in commercial LPUE indices between 1978 and 1992 suggests that SSB levels were higher prior to the 1984-1993 time period. The age-based methods used in this assessment were restricted to a relatively short time period (1984-1993); NEFSC survey data indicate that stock biomass was higher in the 1970s than at present.

Special Comments: Discard mortality in the commercial and recreational fisheries is about 21% of the total catch by number (1984-1993), but imprecisely estimated with the current level of sampling. In addition, there is some uncertainty in the population estimates due to a refuge effect in the habitat preferred by black sea bass, which results in highly variable survey abundance indices. The low precision of the VPA stock size estimates precluded any reliable catch forecasts for 1994 and 1995.

Source of Information: Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 95-18; Assessment of black sea bass (*Centropristis striata*), Shepherd, G.R. and M.C. Lambert, NEFSC Ref. Doc. 95-17.

Black Sea Bass

Trends in Total Catch and Fishing Mortality
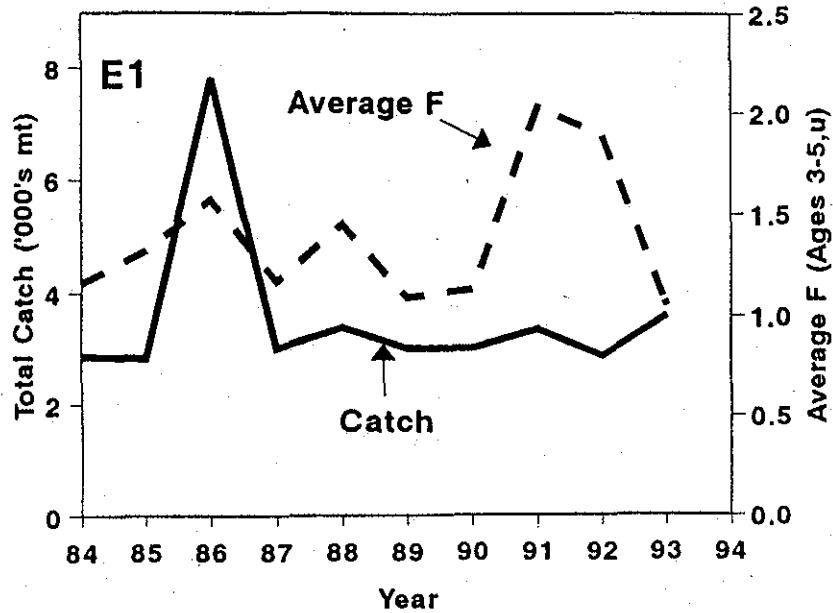
Trends in Stock Biomass and Recruitment
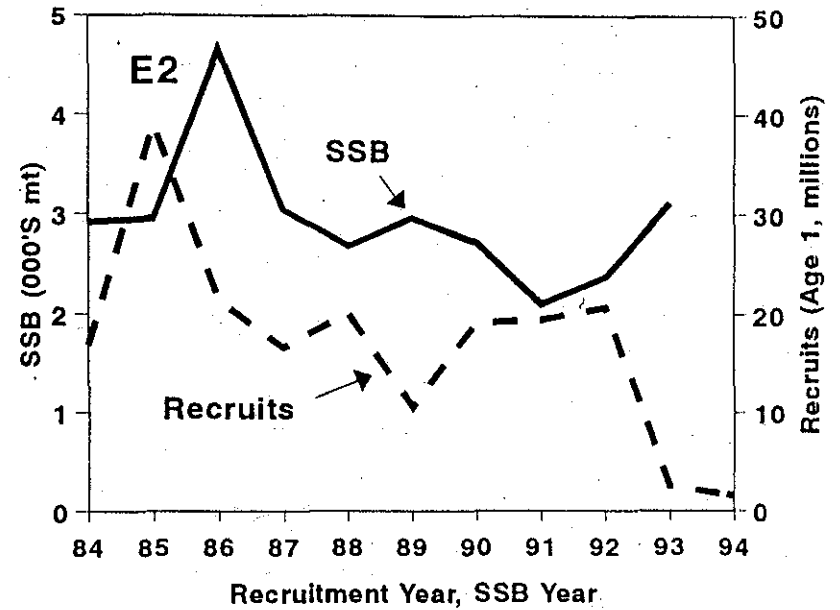
Yield per Recruit
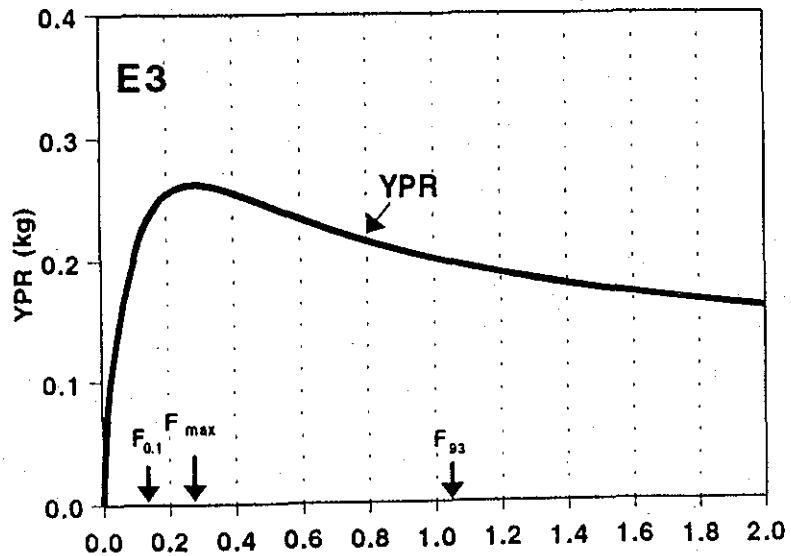
NEFSC Survey Indices
Recruitment Age 1
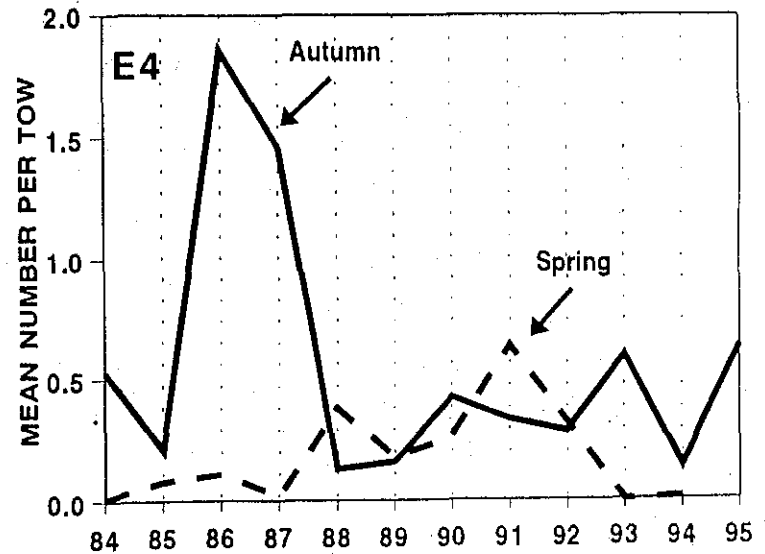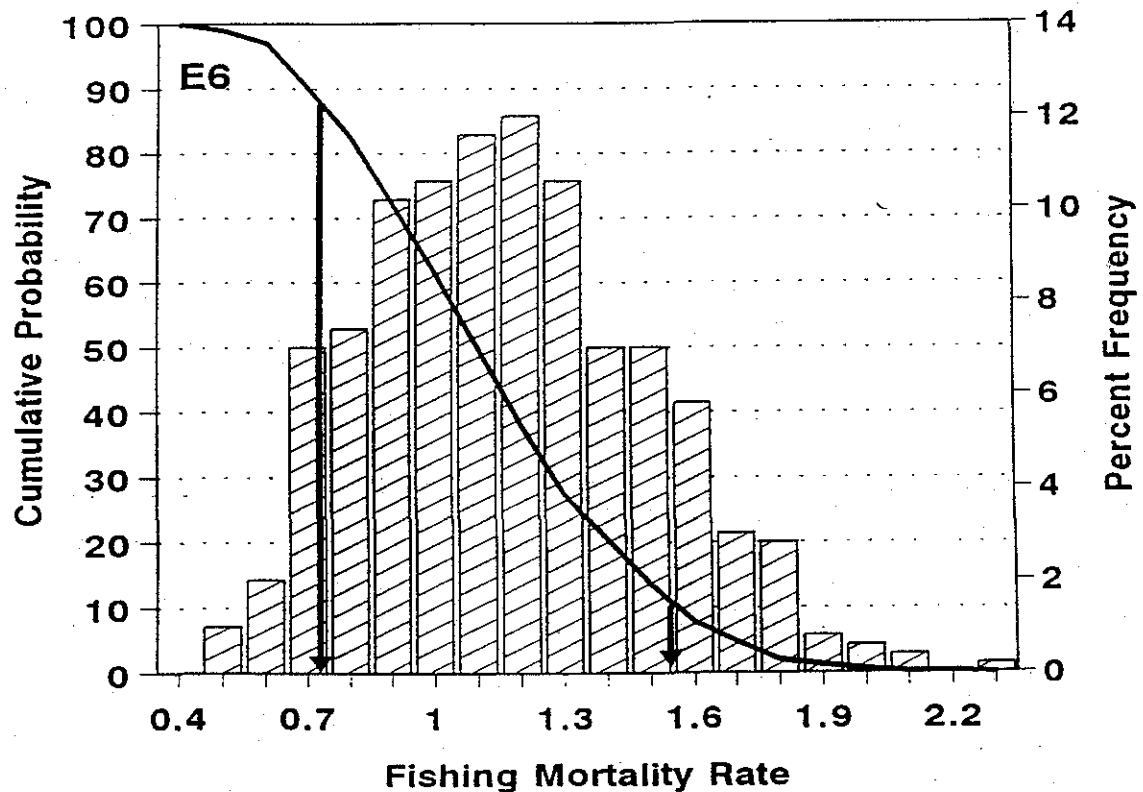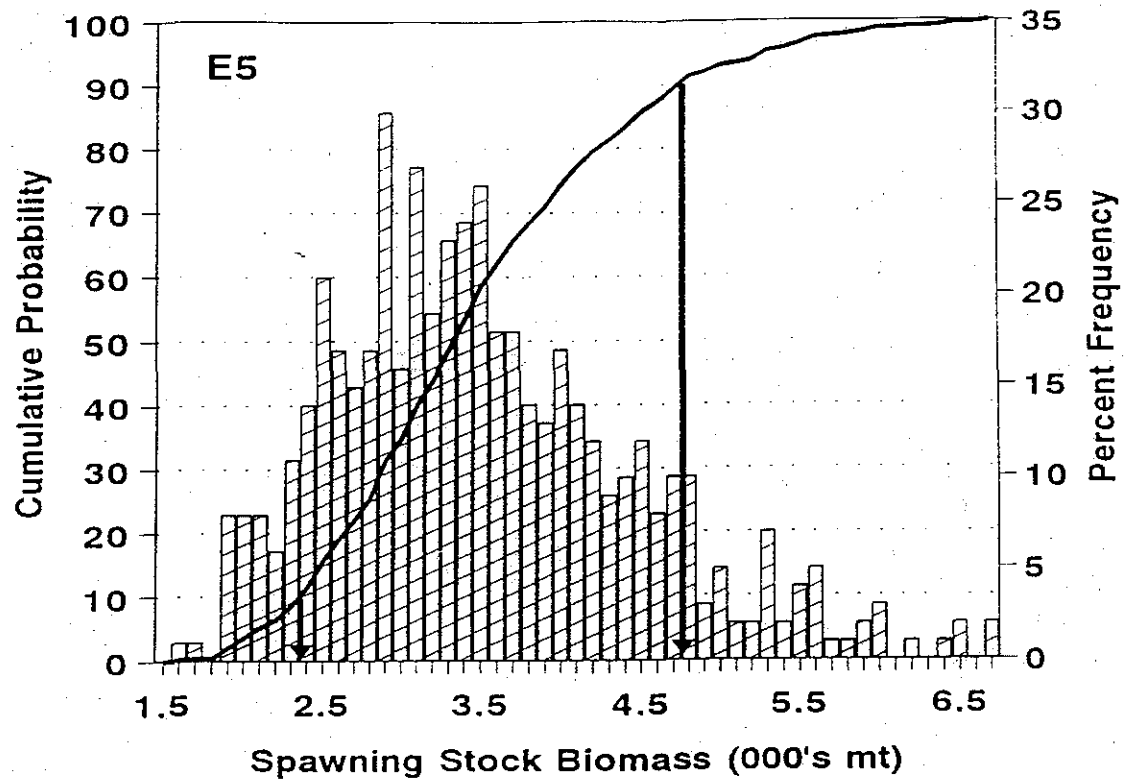
Figures E5 and E6. Precision of the estimates of spawning stock biomass, SSB (E5) and fishing mortality, F (E6), for black sea bass. The bar height indicates the probability of values within that range. The solid line gives the probability that SSB is less than or F is greater than the corresponding value on the X-axis. The arrows indicate the approximate 90% and 10% confidence levels for SSB and F.

F. TAUTOG ADVISORY REPORT

State of stock: Tautog resources in the region from Massachusetts to New York are overexploited (Figure F3) and at a low biomass level (Figure F2). There has been an apparent increase in fishing mortality, and fishing mortality appears to be well above any candidate biological reference point (F_{max}, $F_{0.1}$, F=M) for this long lived and slow growing species. The status of the resource in the region from New Jersey to Virginia could not be fully evaluated because of incomplete data.

Management Advice: Management measures to reduce fishing mortality should be implemented as soon as possible.

Forecast for 1995: No forecasts were performed.

Landings and status table (weight in '000 mt): Tautog

Year	1989	1990	1991	1992	1993	1994	Mean[1]	Min[1]	Max[1]
Recreational landings	2.9	2.3	3.7	3.5	2.4	1.4	3.2	1.4	7.7
Recreational discards	estimates available for the MA-NY area only[2]								
Commercial landings	0.46	0.40	0.50	0.46	0.23	n/a	0.32	0.15	0.54
Commercial discards	estimates not currently available								

[1] Over the period 1981-1994 for recreational catch, 1981-1993 for commercial catch.
[2] The average of recreational discards in the MA-NY area (1981-1993) is 0.42 mt (0.63 in 1993).

Stock Identification and Distribution: Tautog are distributed from Massachusetts to Virginia. For assessment purposes, the stock was divided into two subareas: Massachusetts to New York and New Jersey to Virginia.

Catches: Total recreational landings (Massachusetts to Virginia) fluctuated without trend from 1981 through 1985 averaging 2,521 mt (Figure F1). Landings increased to 7,700 mt in 1986 and averaged 4,100 mt in 1987-1988. Recreational landings have declined since the mid-1980s and reached a record low of 1,400 mt in 1994. Total commercial landings have generally declined since 1987 to a recent low of 240 mt in 1993 (Figure F1).

Data and Assessment: Trends in fishery independent surveys, catch curve analyses, tagging data, analytical assessment of 1982-1993 total landings with ADAPT method and catch at age data from NY, CT, RI, and MA surveys were examined. All catches (trawl surveys, recreational and commercial) were aged using an age-length key from CT trawl survey. Age-length keys were augmented using RI age-length data from 1987-1993. Length frequencies of recreational discards (B2) were estimated from samples from a New York recreational survey. A discard mortality of 25% was assumed. Length frequency of the commercial catches were assumed to be similar as annual MRFSS length frequency >= 13 inches. Commercial discards were not estimated. Natural mortality was assumed to be 0.15.

Biological Reference Points: Preliminary estimates of biological reference points, derived using the selectivity pattern for ages 1-8 from a separable VPA and a flat-topped recruitment pattern assumed after age 8 were $F_{0.1}=0.13$, $F_{30\%}=0.24$ and $F_{max}=0.28$ (Figure F3).

Fishing Mortality: Fishing mortality from survey catch curves averaged 0.58 from 1988-1992. A Rhode Island tagging study estimated fishing mortality as 0.71 (95% CI 0.48 - 0.95). Terminal year fully recruited fishing mortality from the VPA analysis was 0.71 with a CV of 55% (Figure F4).

Recruitment: Estimates are not available.

Spawning Stock Biomass: No reliable estimates are available but available state survey abundance indices indicate record low levels of abundance (Figure F2).

Special Comments: The SARC noted serious problems with the VPA results due to incomplete data sets and inadequate age-length keys. The SARC concluded that these data-problems and the high level of uncertainty in the VPA-results rendered estimates of stock size unreliable for drawing conclusions about the absolute level of current spawning stock size and recruitment, and inappropriate for use in projections. The SARC agreed that a VPA estimate of fishing mortality in the terminal year (with an estimate of its precision), taken together with mortality estimates from other sources, could be used to draw conclusions about current levels of exploitation. Conclusions apply only to the portion of the stock found in the Massachusetts to New York region.

Source of Information: Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessment, NEFSC Ref. Doc. 95-18; Assessment of tautog (*Tautoga onitis*), 1995 report of the SARC Coastal/Pelagic Subcommittee.

Recreational and Commercial Catch of Tautog for MA-NY and
NJ-VA areas (1981-1993).
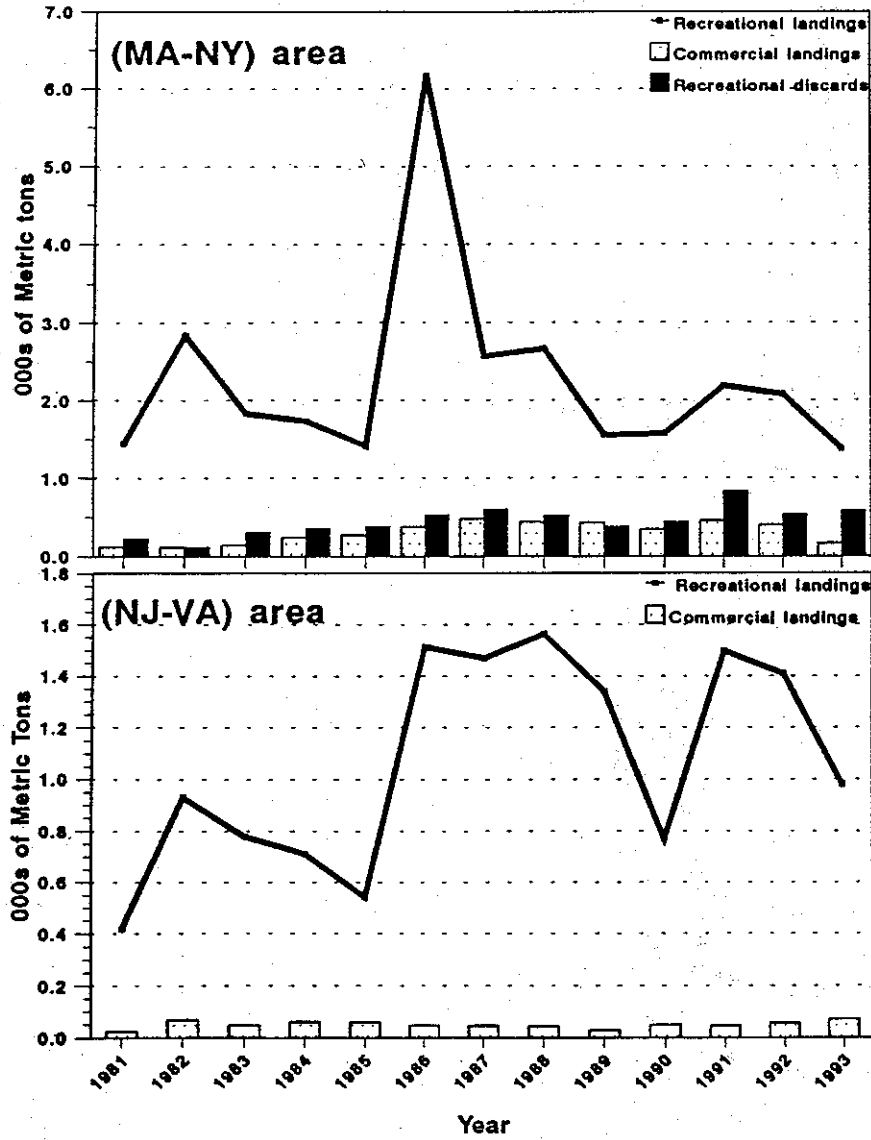
Transformed abundance indices from Massachusetts, Rhode Island, Connecticut, and New York trawl surveys
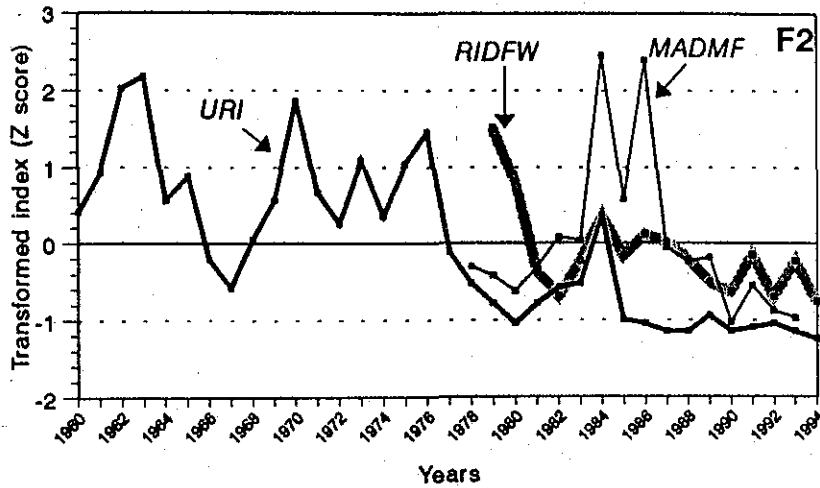
URI=University of Rhode Island / MADMF=Massachusetts Division of Marine Fisheries
RIDFW=Rhode Island Division of Fish and Wildlife

NYDEC = New York Department of Environmental Conservation
CTDEP = Connecticut Department of Environmental Protection

Yield and Spawning Stock Biomass per Recruit (M=0.15)

Point estimates of fishing mortality
from VPA, RI tagging data, and estimates of Z from MA, RI, and CT trawl surveys

CONCLUSIONS OF THE SAW STEERING COMMITTEE

Page 44
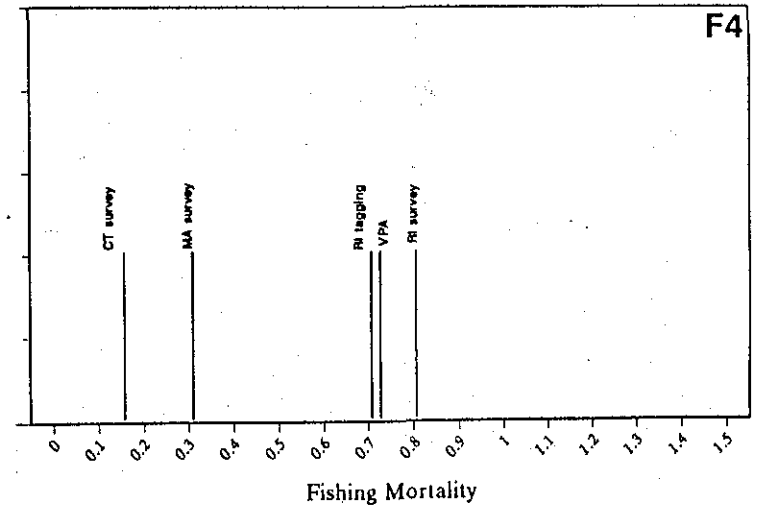
CONCLUSIONS OF THE SAW STEERING COMMITTEE

(Committee Members: J. Dunnigan, ASMFC; D. Keifer, MAFMC; D. Marshall, NEFMC; A. Peterson, NMFS/NEFSC; A. Rosenberg, NMFS/NER)

The SAW-20/21 Steering Committee Meeting was held on 15 August 1995 in Philadelphia, Pennsylvania. Frank Lockhart (in person) and George Lapointe (by telephone) represented the ASMFC; and Patricia Kurkul represented NMFS/NER. Other participants, were Fred Serchuck (Chief Conservation and Utilization Division) Terry Smith (SAW Chair) and Helen Mustafa (SAWs Coordinator), NEFSC.

Dr. Terry Smith led the discussions outlined in the agenda (Table 2). He highlighted the SAW-20 meetings and reviewed the documentation. The Committee set the species and dates for the SAW-21 SARC Meeting and SAW Public Review Workshop, discussed and partially approved the species terms of reference, suggested species for SAW-22 and 23 and evaluated the SAW process.

1. SAW-20

Reviewed were the Subcommittee meetings where the species terms of reference for SAW-20 were addressed (Table 3). Individual participation at these meetings has generally increased, especially the number of representatives from the States and the ASMFC. Currently Subcommittee meetings are announced, together with other meetings in a particular SAW cycle, and participation is invited as appropriate.

This was the SARC's first experience in having an industry representative on the panel (Table 4). The summer flounder industry representative participated fully in the SARC process and was a welcome addition to the panel.

Table 2. SAW-20/21 Steering Committee Meeting Agenda.

Radisson Hotel Philadelphia Airport
Philadelphia, Pennsylvania
15 August 1995
(Beginning at 11:00 AM)

AGENDA

1. Report on SAW-20 Meetings
   a. SARC Meeting
   b. SAW Public Review Workshop
      -Session South
      -Session North
   c. Advisory Document
   d. Plenary/Saw Public Review Workshop Report

2. Research Recommendations

3. SAW-21
   a. Meeting Dates and Places
      -SARC Meeting, 27 November-1 December 1995, Woods Hole
      - SAW Public Review Workshop
         Session North, NEFMC Meeting
         Session South, MAFMC Meeting
   b. Species
      -proposed: American lobster, short-finned squid, long-finned squid, winter flounder, American shad, Northeast groundfish complex
   c. Terms of Reference

4. Future SARC and Public Review Workshops
   a. SAW-22
      -SARC Meeting, date and place
      -SAW Public Review Workshop, MAFMC and NEFMC
      - suggested species: summer flounder, monkfish, sea scallop, bluefish, white hake, American plaice, haddock
   b. SAW-23
      meeting dates, places, and species

5. SAW Process
   a. Meetings
   b. Documentation

6. Other Business

Table 3. SAW-20 Subcommittee meetings.

Subcommittee - Species Analysis Attendance		Meeting Date and Place
Northern Demersal Subcommittee - GEORGES BANK HADDOCK		
A. Applegate, NMFS/NEFMC	L. Hendrickson, NMFS/NEFSC	30 May - 2 June 1995
R. Brown, NMFS/NEFSC	R. Mdayo, NMFS/NEFSC (Chair)	Woods Hole, MA
S. Cadrin, MA DMF	L. O'Brien, NMFS/NEFSC	
L. VanEeckhaute, DFO, Canada	K. Sosebee, NMFS/NEFSC	
S. Gavaris, DFO, Canada	M. Terceiro, NMFS/NEFSC	
T. Helser, NMFS/NEFSC	S. Wigley, NMFS/NEFSC	

Southern Demersal Subcommittee - SUMMER FLOUNDER

S. Aicher, NYS DEC	J. Mason, NYS DEC	15 - 19 May 1995
W. Gabriel, NMFS/NEFSC (Chair)	S. Michels, DEDFW	Woods Hole, MA
M. Gibson, RI DEM	R. Monaghan, NC DMF	
H. Goodale, NMFS/NERO	C. Moore, MAFMC	
G. Gray, NMFS/MRFSS	D. Simpson, CT DEP	
F. Gregoire, DFO, Canada	K. Sosebee, NMFS/NEFSC	
M. Lambert NMFS/NEFSC	M. Terceiro, NMFS/NEFSC	
N. Lazar, ASMFC		

The following persons did not attend the meeting but
provided data used in the assessment:
S. Correia, MA DMF
S. Doctor, MD DNR
J. Musick, VIMS

Pelagic/Coastal Subcommittee - ATLANTIC MACKEREL
BLACK SEA BASS
TAUTOG

S. Aicher, NY DEC	S. Michels, DE DFW	15 - 19 May 1995
E. Anderson, NMFS/NEFSC, (Chair)	R. Monaghan, NC DMF	Woods Hole, MA
J. Brodziak, NMFS/NEFSC	C. Moore, MAFMC	
K. Friedland, NMFS/NEFSC	W. Overholtz, NMFS/NEFSC	
W. Gabriel, NMFS/NEFSC	P. Rago, NMFS/NEFSC	
M. Gibson, RI DFW	R. Seagraves, MAFMC	
H. Goodale, NMFS/NERO	F. Serchuk, NMFS/NEFSC	
G. Gray, NMFS/MRFSS	G. Shepherd, NMFS/NEFSC	
F. Gregoire, DFO Canada	D. Simpson, NMFS/NEFSC	
M. Lambert, NMFS/NEFSC	K. Sosebee, NMFS/NEFSC	
N. Lazar, ASMFC	M. Terceiro, NMFS, NEFSC	
J. Mason, NY DEC		

Invertebrate Subcommittee - SEA SCALLOP

A. Applegate, NEFMC	J. Idoine, NMFS/NEFSC	22 - 26 May 1995
J. Brodziak, NMFS/NEFSC	H.-L. Lai, NMFS/NEFSC	Woods Hole, MA
J. Brust, VIMS	P. Rago, NMFS/NEFSC, (Chair)	
R. Conser, NMFS/NWFSC	A. Richards NMFS/NEFSC	
W. DuPaul, VIMS	P. Spalt. Cape Oceanic Coop. (part-time)	
W. Gabriel, NMFS/NEFSC	J. Weinberg, NMFS/NEFSC	
L. Hendrickson, NMFS/NEFSC	S. Wigley, NMFS/NEFSC	

Table 4. Composition of the SARC.

Chair: SAW-20 Chairman

Terry Smith, NEFSC

Four ad hoc experts chosen by the Chair:

**Marinelle Basson, NEFSC
Ray Conser, NMFS, Hatfield Marine Science Center
Kevin Friedland, NEFSC
Josef Idoine, NEFSC**

One person from NMFS, Northeast Regional Office:

Peter Colosi, NERO

One person from each Regional Management Council:

**Andy Applegate, NEFMC
Chris Moore, MAFMC**

Atlantic States Marine Fisheries Commission/State personnel:

**Steve Correia, MA DMF
Robert O'Reilly, VA MRC
Harry Upton, ASMFC**

One scientist from:

Canada - **Stratis Gavaris, DFO**
Academia - **Diane Brousseau, Fairfield University**
Other Region - **Douglas Vaughan, NMFS/SEFSC**

Industry Representative:

Karl English, LGL Limited

Although more than one species analysis may be presented on any one meeting day, in the end, only one species/stock per day can realistically be comfortably reviewed (Table 5). As time is limited, the order of the species/stocks on the agenda is important. For example, at this meeting, more time could have been spent in dealing with the tautog assessment, which was presented last, as well as the scallop documentation which was discussed at the end of the week.

Steering Committee members were satisfied that the two sessions of the SAW Public Review Workshop, built into the Councils' agendas, is an effective way to transmit scientific advice to managers. They offered several suggestions including, shortening the introductory part, simplifying and standardizing overhead charts for the species, using scatter diagrams, and finding a consistent way to deal with relative terms such as "good year class".

No changes were recommended to the Advisory Report format. The Advisory report, together with a brief introduction and the Conclusions of the SAW Steering Committee section will be published in the Report of the 20th Northeast Regional Stock Assessment Workshop (20th SAW), SAW Public Review Workshop.

2. Research Recommendations

In the review of research recommendations, it was pointed out that several recommendations will be carried out under US/Canada cooperative research arrangements and the two recommendations that relate to sea sampling will be dealt with through the newly established Ad Hoc Sea-Sampling Working Group. The Sea-Sampling Working Group met since the time of the SARC Meeting and reviewed the terms of reference approved at the last Steering Committee meeting (February 1995). Dave Pierce (MA DMF) volunteered to Chair the group. The working group should be able to report at the SAW-21 SARC meeting.

Among the recommendations were several which will expand the terms of reference of the Assessment Methods Subcommittee. As Ray Conser has left the NEFSC, a new chair is needed to head this group.

Table 5. Agenda of the 20th Northeast Regional Stock Assessment Workshop (SAW-20) Stock Assessment Review Committee (SARC) Meeting.

NEFSC Aquarium Conference Room
166 Water Street
Woods Hole , Massachusetts
Telephone: 508-548-5123
19 - 23 June 1995

AGENDA

SPECIES/STOCK	SUBCOMMITTEE & PRESENTER	SARC LEADER	RAPPORTEUR
MONDAY, June 19 (1:00 PM - 7:30 PM)			
Opening Welcome Agenda Conduct of Meeting		T.P. Smith, Chairman	H. Mustafa
Ad Hoc Working Group on Sea- Port-Sampling Report (G)	Chairman		
Haddock (A)	No. Demersal R. Mayo	S. Gavaris	R. Brown
Approve "points" for Advisory Report			
TUESDAY, June 20 (9:00 AM - 6:00 PM)			
Summer Flounder (B)	So. Demersal W. Gabriel	M. Basson	M. Terceiro
Approve "points" for Advisory Report			
Black Sea Bass (E)	Pelagic/Coastal G. Shepherd	D. Vaughan	D. Simpson
Approve "points" for Advisory Report			
Review available draft sections for the SARC report			
WEDNESDAY, June 21 (9:00 AM - 6:00 PM)			
Mackerel (C)	Pelagic Coastal J. Brodziak	K. Friedland	T. Helser
Approve "points" for Advisory Report			
Sea Scallop (D)	Invertebrate P. Rago	D. Brousseau	H.-L. Lai
Approve "points" for Advisory Report			
Review available draft sections for the SARC report			

Table 5. (Continued)

THURSDAY, June 22 (9:00 AM - 6:00 PM)............:..

Sea Scallop (D) -- Continued

Tautog (F)	Pelagic/Coastal	S. Correia	M. Gibson
	N. Lazar		

  , Approve "points" for Advisory Report

Review available documentation

FRIDAY, June 23 (9:00 AM - 6:00 PM)

Review all Research Recommendations

Complete SARC Report sections   H. Mustafa
(Coordinator)

Complete Advisory Report and review final draft

Other Business   H. Mustafa

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3. SAW-21

Meeting dates and places:

SAW-21 Stock Assessment Review Committee (SARC) Meeting

NEFSC Woods Hole, MA
27 November - 1 December 1995

SAW Public Review Workshop

Session South - MAFMC Meeting, New York, NY, 19-21 December 1995 or first meeting in 1996

Session North - NEFMC Meeting, first meeting in 1996

Species/Stocks:

Long-finned Squid (*Loligo*)
Short-finned Squid (*Illex*)
Winter Flounder
Atlantic Herring
Northeast Groundfish Complex

The need to review a bluefish assessment at SAW-21 was discussed at some length. It was concluded that in order to meet the current needs of the ASMFC and MAFMC, the assessment developed in the SAW-18 process could be updated by the Bluefish Monitoring Committee with the support of NEFSC staff.

Terms of Reference:

LONG-FINNED SQUID (*Loligo*)

a. Examine the seasonal and annual distribution patterns and relationship to environmental parameters, especially temperature;

b. Estimate relative abundance, biomass, and mortality rates;

c. Review overfishing definitions and incorporate recently revised life history information;

d. Examine harvesting strategies in relation to stock dynamics.

SHORT-FINNED SQUID (*Illex*)

a. Examine the seasonal and annual distribution patterns and relationship to environmental parameters, especially temperature;

b. Estimate relative abundance, biomass, and mortality rates;

c. Review overfishing definitions.

WINTER FLOUNDER

Southern New England-Mid-Atlantic Stock Complex:

a. Review the basis for stock complex definitions;

b. Summarize landings, length composition and available age/length data; summarize discard and available length data;

c. Summarize available indices of stock abundance/ biomass based on commercial, recreational and research survey data sources;

d. Estimate age composition of landings and discards;

e. Subject to adequate data, conduct an analytical assessment;

f. Develop/revise yield-per-recruit and spawning stock biomass-per-recruit reference point calculations.

Georges Bank Stock:

a. Summarize landings, length composition and available age/length data; summarize discard and available length data;

b. Summarize available indices of stock abundance/ biomass based on commercial, recreational and research survey data sources;

c. Estimate age composition of landings and discard;

d. Subject to adequate data, conduct an analytical assessment;

e. Develop/revise yield-per-recruit and spawning stock biomass-per-recruit reference point calculations.

Gulf of Maine Stock Complex:

a. Summarize landings, length composition and available age/length data; summarize discard and available length data;

b. Summarize available indices of stock abundance/ biomass based on commercial, recreational and research survey data sources;

c. Develop recommendations for future data collection and analytic approaches;

d. Develop/revise yield-per-recruit and spawning stock biomass-per-recruit reference point calculations.

ATLANTIC HERRING

a. Provide an age-structured assessment of the herring stock complex, including estimates of fishing mortality, spawning stock biomass and exploitable biomass through 1994, and characterize the uncertainty of the terminal estimates of F and SSB;

b. Provide short-term projections of catch and SSB at various levels of F;

c. Review the overfishing definition and long-term harvest strategy for this stock complex.

NORTHEAST GROUNDFISH COMPLEX

a. Provide current indices of abundance and biomass for individual stocks comprising the Northeast Demersal Complexes, especially the 10 regulated species in the Northeast Multispecies FMP;

b. Provide an analysis of temporal and spatial trends in the distribution of species comprising the Northeast Demersal Complexes;

c. Evaluate methods of forecasting spawning stock biomass, based upon historical relationships between research vessel survey data and virtual population estimates (including extending time-series backward to include years not used in analytical assessments);

d. Evaluate the bycatch implications of the multispecies trawl and fixed gear fisheries for Northeast groundfish on the ability to meet fishing mortality rate goals for individual species/stocks.

AMERICAN LOBSTER

Discussion of lobster terms of reference and the need for another lobster assessment at SAW-21 continued after the meeting. It was concluded that NMFS' Senior Scientist would convene a panel of international experts to review alternative hypotheses that would attempt to explain why US stocks have not experienced recruitment failure despite continued high fishing mortality rates and record-high nominal fishing effort. The panel would also examine the basis for overfishing definitions for lobster. The panel's report will be reviewed by the SARC as soon as it is available in a special meeting at the beginning of 1996.

4. **Future SAW Meetings**

SAW-22

Suggested meeting dates and places:

Stock Assessment Review Committee (SARC) Meeting
  17-21 June 1996
  NEFSC, Woods Hole, MA

SAW Public Review Workshop
  Session South-MAFMC Meeting, 6 - 8 August 1996, Wilmington, DE
  Session North-NEFMC Meeting, 21-22 August 1996, Danvers, MA

Suggested Species/Stocks:

Summer Flounder (update)
Bluefish
Monkfish
Sea Scallop (if possible)
American Plaice
Southern New England Yellowtail Flounder

SAW-23

Suggested date and place for the SARC meeting:
  18 - 22 November 1996, NEFSC Woods Hole, MA

Suggested Species/Stocks:

Georges Bank Cod
Shad
Georges Bank Yellowtail Founder
Weakfish
Butterfish
Northern Shrimp
If there is a resource survey in 1996 --
  Surfclam
  Ocean Quahog
If there is no surfclam/ocean quahog survey --
  Silver Hake

See Table 6 for a chronology of past assessment reviews by species.

5. **SAW Process**

Discussed was the possibility of changing the format of the current SARC Consensus Summary of Assessments (SARC report), or doing away with the SARC report altogether and publishing in the NEFSC Reference Documents series only the assessment papers, each under a separate cover. The

Steering Committee concluded, however, that the SARC report, as a collection of self-sustaining analyses, is an accepted, handy reference and should be continued.

Barring any unforeseen need to hold face-to-face meetings, it was agreed to hold future Steering Committee meetings by teleconference.

Table 6.

SAW/SARC Assessment Reviews by Species

YEAR	85	1986		1987		1988		1989		1990		1991		1992		1993		1994		1995		1996	
SAW #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
BLACK SEA BASS	X				+	+			X		X		X							X			
BLUEFISH	X		X	X	X	X					X							X	X			X	
BUTTERFISH	X	X		X		X		X		X		X					X						X
COD, Georges Bank	X		X				X			X		X		X				X					X
COD, Gulf of Maine	X		X				X						X		X				X				
CUSK	X																						
FLDR, AM. PLAICE	X	X		X							X			X								X	
FLDR, SUMMER	X		X			X	+	+	X		X		X			X		X		X		X	
FLDR, WINTER	X		X																		X		
FLDR, WINTER-INSH.	X		X		+	+	+						X										
FLDR, WITCH	X	X																X					
FLDR, Yellowtail, SNE	X	X					X					X					X					X	
FLDR, Yellowtail, GB																			X				X
GOOSEFISH														X								X	
HADDOCK-Georges Bank	X	X		X									X							X			
HADDOCK-Gulf of Maine	X	X																					
HERRING					X				X		X		X			X					X		
LOBSTER	X		X						X		X			X		X					X		
MACKEREL, ATLANTIC	X	X		X		X		X		X		X								X			
OCEAN POUT	X										X												
OCEAN QUAHOG	X		X							X					X				X				X
POLLOCK	X		X							X	X					X							
RED HAKE	X	X									X												
REDFISH	X	X													X								
RIV. HERRING/SHAD	X					X																	X
SALMON	X																						
SCALLOPS	X	X				X			X	X	X	X	X	X						X	X		
SCUP	X			X			X		X		X						X						
SHRIMP, NORTHERN	X		X		X																		X
SILVER HAKE	X	X		X						X	X					X							X
SKATES	X																						
SPINY DOGFISH	X									X								X					
SQUID, ILLEX	X	X		X		X		X		X		X		X			X				X		
SQUID, LOLIGO	X	X		X		X		X		X		X		X			X				X		
STRIPED BASS	X																						
SURF CLAM	X		X				X		X						X			X		X			X
TAUTOG																				X			
TILEFISH	X												X		X								
WEAKFISH			+																				X
WHITE HAKE	X	X									X								X				
WOLFFISH	X																						

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