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A Report of the 21st Northeast Regional Stock Assessment Workshop

21st Northeast Regional Stock Assessment Workshop (21st 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

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This report is a product of the 21st Northeast Regional Stock Assessment Workshop (21st SAW). Proceedings and products of the 21st SAW are scheduled to be documented and released as subissues (denoted by a lower case letter) of *Northeast Fisheries Science Center Reference Document* 96-05 (*e.g.*, 96-05a). Tentative titles for the 21st SAW are:

An index-based assessment of winter flounder populations in the Gulf of Maine

Assessment of winter flounder in Southern New England and the Mid-Atlantic

Influence of temperature and depth on the distribution and catches of yellowtail flounder, Atlantic cod, and haddock in the NEFSC bottom trawl survey

Predicting spawning stock biomass for Georges Bank and Gulf of Maine Atlantic cod stocks with research vessel survey data

Preliminary results of a spatial analysis of haddock distribution applying a generalized additive model

Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW): Public Review Workshop

Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments

Stock assessment of northern shortfin squid in the Northwest Atlantic during 1993

The Lorenz curve method applied to NEFSC bottom trawl survey data

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OVERVIEW

The SAW Public Review Workshop of the 21st Northeast Regional Stock Assessment Workshop (21st 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 Atlantic City, Maryland on 21 February 1996 and Session North, during the New England Fishery Management Council Meeting at Danvers Massachusetts on 26 February 1996.

The purpose of the Workshop was to present to managers, industry representatives, and others the results of the peer review of assessments on long-finned (*Loligo*) and short-finned (*Illex*) squid, Atlantic herring, and Southern New England/Mid-Atlantic and Gulf of Maine winter flounder, and peer reviewed analysis of the northeast demersal complex, as well as relevant management advice.

Presentations at both sessions were made by the 21st SAW Chairman, Dr. Terry Smith of the NMFS, Northeast Fisheries Science Center. The presentation material was based on the Advisory Report section contained in this report. Presentation emphasis at each meeting was on adjusted according to each Council's management interest in a particular topic.

Draft copes 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.

ADVISORY REPORT ON STOCK STATUS

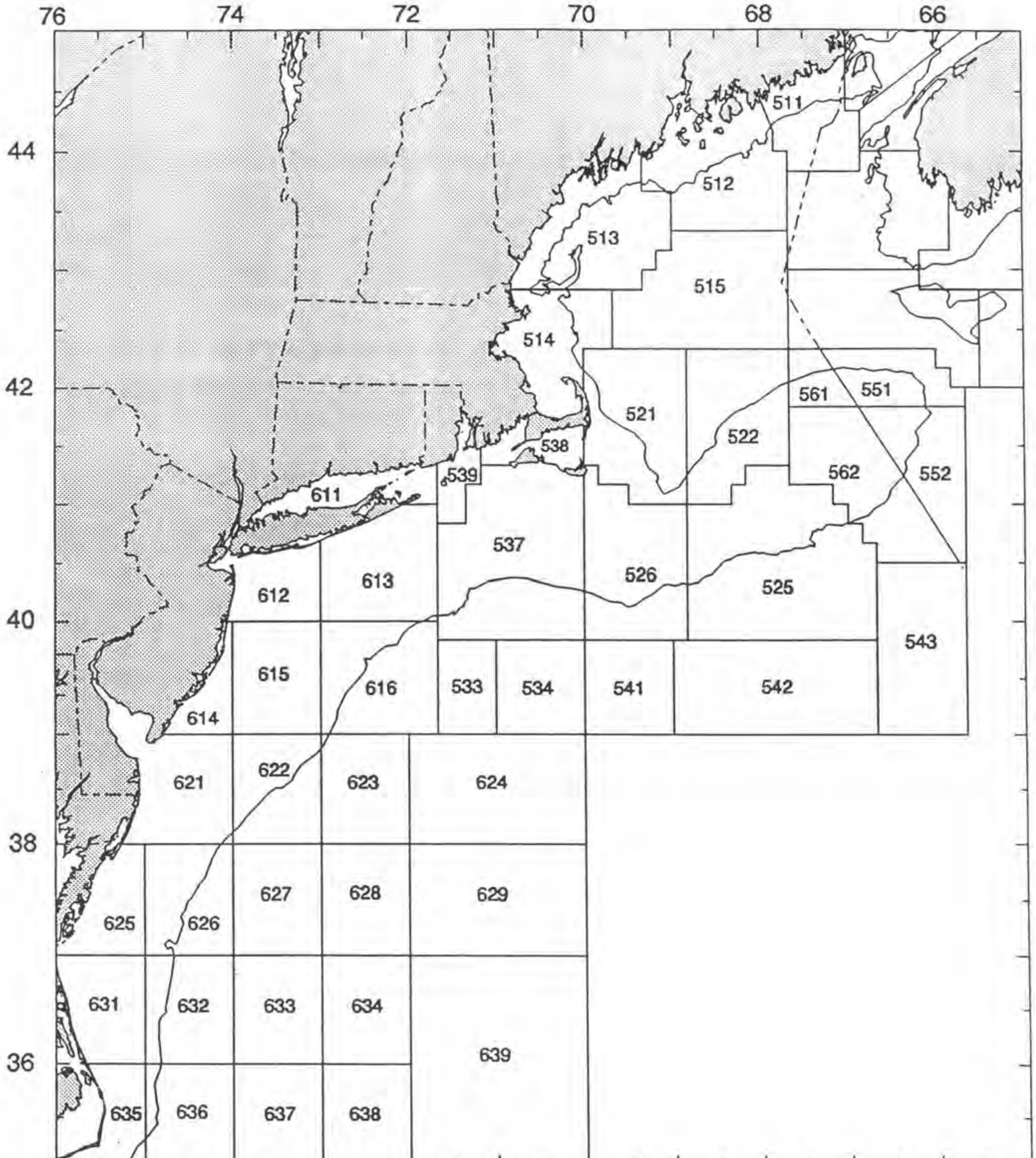


Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the northeast United States.

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 (SARK), 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.

EXPLOITATION STATUS	STOCK LEVEL: LOW	MEDIUM	HIGH
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	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 the number of deaths is proportional to the number present, 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 ($1,000,000 \times (1-0.00548)^{(365)}$). 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 (2/8,760 hours per year) and we would calculate that there would be 135,304 fish remaining at the end of the year ($1,000,000 \times (1-0.00228)^{(8760)}$). 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, that is,

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

or, for our 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. Percentage of stock (in numbers) caught annually or monthly, as in the case of the two squid species, (i.e., exploitation rate) for different natural (M) and fishing (F) mortality rates for species considered in this report.

F	M = 0.05 Redfish	M = 0.15 Witch flounder	M = 0.2 See species list below[1]	M = 0.3[2] *Illex* and *Loligo*	M = 0.4 Silver hake Red hake	M unknown See species list below[3]
0.1	9	9	9	8	8	
0.2	18	17	16	16	15	
0.3	25	24	24	23	22	
0.4	32	31	30	29	28	
0.5	38	37	36	34	33	
0.6	44	42	41	40	38	
0.7	49	47	46	44	42	
0.8	54	52	51	49	47	
0.9	58	56	55	52	50	
1.0	62	59	58	56	54	
1.1	65	63	62	59	57	
1.2	68	66	65	62	60	
1.3	71	69	67	65	62	
1.4	74	71	70	67	65	
1.5	76	73	72	70	67	
1.6	78	76	74	72	69	
1.7	80	77	76	73	71	
1.8	82	79	78	75	73	
1.9	84	81	79	77	74	
2.0	85	82	81	78	76	

[1]Cod, haddock, pollock, white hake, yellowtail flounder, winter flounder, American plaice, windowpane flounder, goosefish, and Atlantic herring.
[2]Monthly rate in contrast to annual rate for the other listed species.
[3]Windowpane flounder, cusk, wolffish, and ocean pout.

A. LONG-FINNED *(Loligo)* SQUID ADVISORY REPORT

State of Stock: Stock biomass in the fall of 1994 was high and the stock fully exploited (Figure A4). Biomass has fluctuated considerably during 1967-1994, consistent with the fact that *Loligo* has a life span of only one year. Current exploitation rates for the summer fishery are slightly above and for the winter fishery greatly above the biological reference point $F_{50\%}$ (Figure A7). Utilization rates for these fisheries have generally been below F_{max}. The level of discarding is uncertain in this assessment. If discarding is substantial exploitation rates have been underestimated.

Management Advice: To maintain current yield levels, the exploitation rate should not be increased. Because *Loligo* has a life span of less than one year, the potential for recruitment overfishing is substantial. Failure to ensure an adequate level of spawning escapement can jeopardize both the stock and the fishery. If *Loligo* are captured too small in size, significant potential yield is sacrificed because growth is rapid in the last six months of life. A fixed annual quota of 21,000 mt would result in exceeding the target fishing mortality rate (i.e., $F_{50\%}$) half of the time. A quota of 26,000 mt would exceed this target 74% of the time. If managers wish to capitalize on above-average recruitment events to increase short-term yields, or avoid overfishing when recruitment is low, development of an intensive in-season management program will be necessary.

Forecast for 1995: No forecasts were made. However, see **Special Comments** section.

Landings and Status Table (weights in '000 mt): Long-finned Squid

Year	1987	1988	1989	1990	1991	1992	1993	1994	Max	Min (1967-1994)	Mean
US Commercial Landings[1]	11.5	19.1	23.7	15.0	19.4	18.2	22.3	22.5	23.7	0.5	8.4
Summer Landings[2]	6.7	11.3	8.0	6.5	9.3	5.3	6.0	-	11.3	5.3	7.6
Winter Landings[3]	-	5.5	14.0	10.2	6.7	14.2	16.7	-	16.7	5.5	11.2
Foreign Commercial Landings[1]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.5	0.0	11.6
Total Commercial Landings[4]	11.5	19.1	23.7	15.0	19.4	18.2	22.3	22.5	37.6	1.7	20.0
Discards	Discards occur but reliable estimates are not available										
Prerecruits, Fall, millions[5]	2.0	17.2	15.0	15.0	11.0	36.9	5.9	16.7	36.9	2.0	13.0
Prerecruits, Spring, millions[5]	0.8	5.1	5.2	5.9	8.2	3.5	1.6	1.6	9.9	0.2	3.3
Stock Biomass, Fall[6]	12.1	39.5	61.3	57.3	57.7	27.8	27.4	80.9	80.9	12.1	45.0
Stock Biomass, Spring[6]	13.0	22.6	30.2	23.4	26.0	14.1	14.8	7.9	30.2	4.3	15.5
Effort, Summer[7]	1017	1140	1134	1098	1275	797	1047	-	1275	797	1073
Effort, Winter[7]	1076	1076	1406	1254	1231	1564	1868	-	1868	1076	1354
LPUE, Summer[8]	4.3	5.0	3.5	3.6	4.4	2.9	2.6	-	5.0	2.6	3.8
LPUE, Winter[8]	4.0	4.6	8.5	6.1	4.6	8.0	8.5	-	8.5	4.0	6.3
Fraction of Stock utilized in 6 mo by:											
Summer Fishery[2]	0.52	0.50	0.27	0.28	0.36	0.38	0.41	-	0.52	0.27	0.39
Winter Fishery[3]	-	0.45	0.35	0.17	0.12	0.25	0.60	-	0.60	0.12	0.32

[1]Based on Calendar Year.
[2]Apr. 1 through Sep. 30 the following year (Max, Min and Mean for the years 1987-1993).
[3]Oct. 1 through Mar. 31 of the following year (Max, Min and Mean for the years 1988-1993).
[4]USA plus Foreign; Based on Calendar Year; This is "Catch Used in Assessment".
[5]NEFSC Seasonal Survey; Diurnal-adjusted; Pre-recruits are <9 cm.
[6]NEFSC Seasonal Survey; Diurnal-adjusted stock weight in '000 mt.
[7]Standard Days Fished by Domestic Fleet (Max, Min and Mean for the years 1987-1993).
[8]MT per Standard Day Fished by Domestic Fleet (Max, Min and Mean for the years 1987-1993).

Stock Distribution and Identification: The stock is distributed from the Gulf of Mexico to Nova Scotia. Within the range of commercial exploitation from Cape Hatteras to the Gulf of Maine, the *Loligo* population is considered to be a unit stock. Cape Hatteras is the southern zoogeographic boundary of the resource. *Loligo* migrate from offshore to inshore during warmer months of the year. The stock was separated into two seasonal components for assessment because there are two relatively distinct inshore and offshore fisheries, and patterns of growth differ between seasonal spawning groups. However, both seasonal fisheries exploit both seasonal spawning groups.

Catches: The magnitude of discards is unknown and may be significant. Annual landings averaged 32,000 mt at the peak of the foreign fishery during 1972-1976 (Figure A1). Landings declined to an average of 15,000 mt during 1977-1979, increased to average 24,000 mt during 1980-1984, then declined to an average of 15,000 during 1985-1987. Foreign fishing was ceased in 1986. During 1988-1989, landings increased again to an average of 21,000 mt before declining to an average of 17,500 mt during 1990-1992. Landings during 1993-1994 averaged 22,000 mt. Beginning in the early 1980s, the domestic fishery began to shift from a primarily inshore, small-vessel fishery to an offshore, large-vessel fishery. Since 1989, the offshore winter fishery has taken about 60% of the annual landings (Figure A5).

Data and Assessment: *Loligo* were last assessed in 1993 (SAW-17). The current assessment relies on estimates of *Loligo* abundance derived from NEFSC survey data. Yield and spawning stock biomass per recruit analyses were performed using new growth and maturity data. This new information resulted in lower estimates of long-term annual yield relative to previous assessments. Likewise, in the **Landings and Status Table,** both effort and LPUE values differ from those reported in SAW 17 because the current assessment is based on a redefined set of vessel classes and fishing seasons which better characterize the fishery.

Biological Reference Points: The fishing mortality that would maintain 50% of the maximum spawning potential of the stock ($F_{50\%}$) was selected as a management target, and F_{max} was selected as an overfishing threshold rate which should be avoided. $F_{50\%}$ was selected based on the fact that *Loligo* spawn only once and then die, and by analogy with squid management in the Falkland Islands. Monthly $F_{50\%}$ was estimated as 0.13 for winter-hatched *Loligo* (Figure A7); monthly F_{max} is 0.38 for winter-hatched *Loligo* (Figure A3). Reference points calculated for summer-hatched *Loligo* were very similar to those listed above ($F_{50\%}$ = 0.14, Figure A7; F_{max} = 0.36, Figure A3), but the expected maximum yield per recruit for this component was much lower, due to slower growth.

Fishing Mortality: The instantaneous utilization rate has remained close to or above the $F_{50\%}$ level since 1987 (Figure A7). The stock appears to have been growth overfished during the winter of 1993. Subsequent landings during the summer of 1993 were slightly below average (Figure A5).

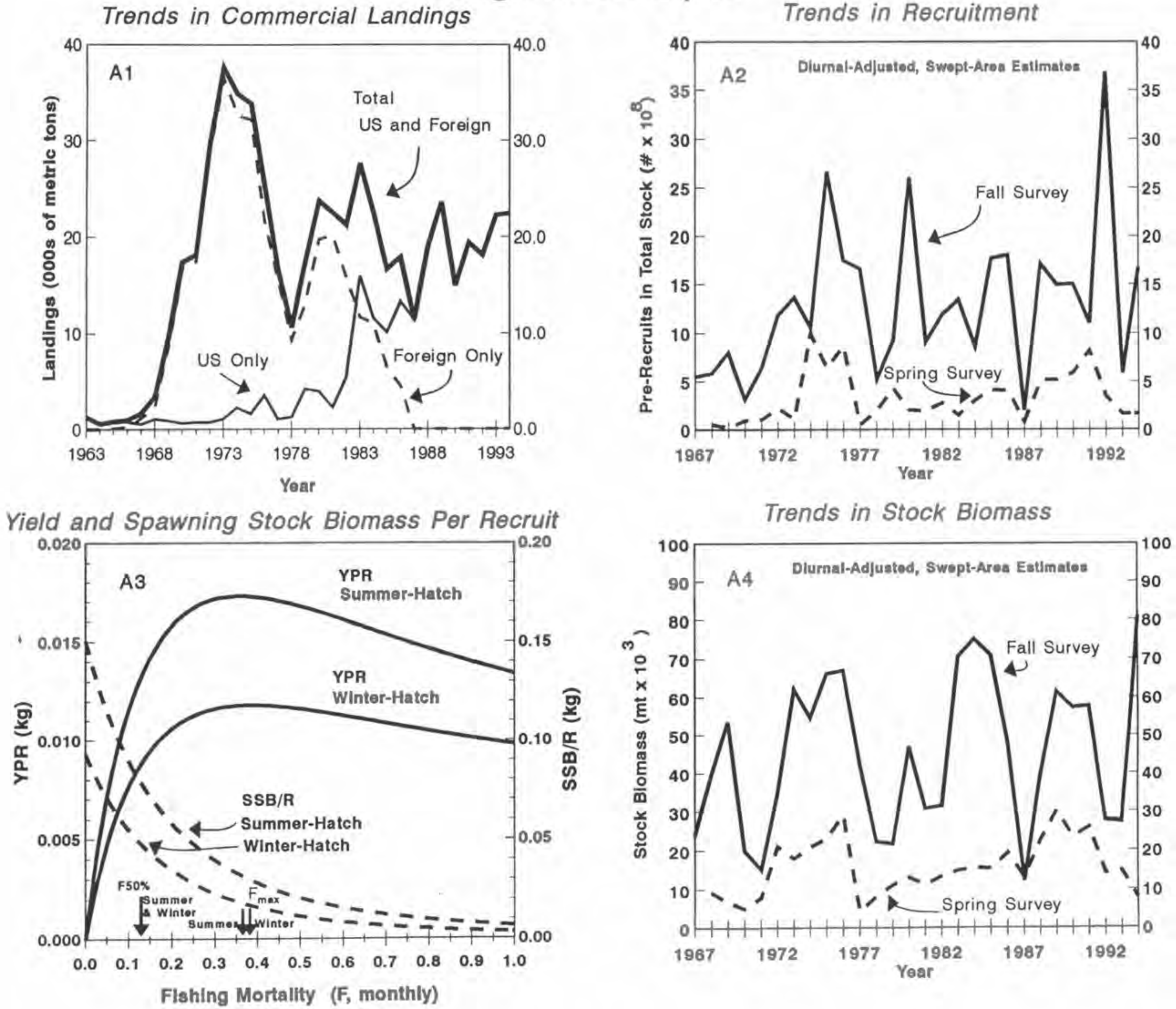
Recruitment: Recruitment (individuals < 9 cm) has varied considerably in recent years (Figure A2). Since 1967, the number of recruits has fluctuated around 1.3 billion in the fall and 0.33 billion in the spring. The estimate of 1993 recruitment was above average at 1.7 billion individuals.

Stock Biomass: Biomass has varied considerably over time, with the 1994 estimate well above average (Figure A4). Biomass has was average during the summers of 1988-1991, but below average during the summers of 1987 and 1992-1993 (Figure A6). Stock biomass was above average during the winters of 1990-1992, but below average during the winters of 1987 and 1993 (Figure A6).

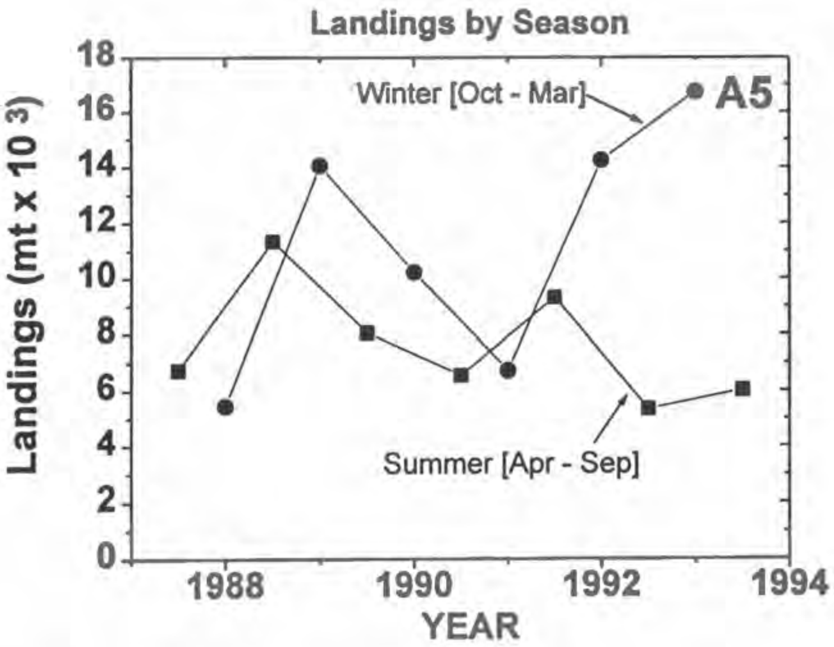
Special Comments: Data analyzed by the SARC indicated a significant negative relationship between winter offshore fishing effort and subsequent summer relative abundance indices (as indicated by commercial LPUE). Although no causal relationship has been established, these data suggest that high levels of offshore effort in the winter fishery may reduce the abundance inshore in the subsequent summer.

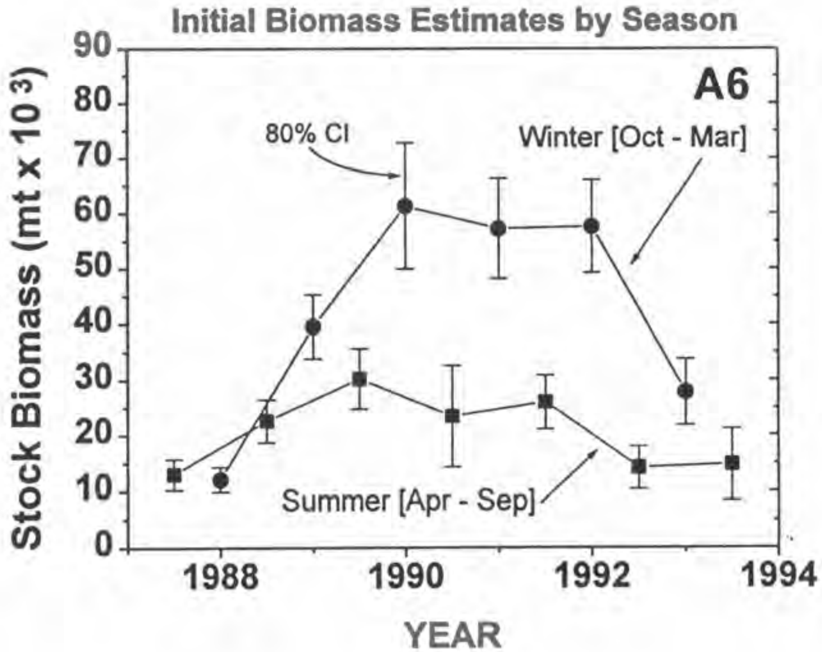
Sources of Information: Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 96-05d); Report of the 17th Northeast Regional Stock Assessment Workshop (17th SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 94-06); Brodziak, JKT and WK Macy, Growth of Long-finned squid, *Loligo pealei*, in the northwest Atlantic, Fishery Bulletin, in press.

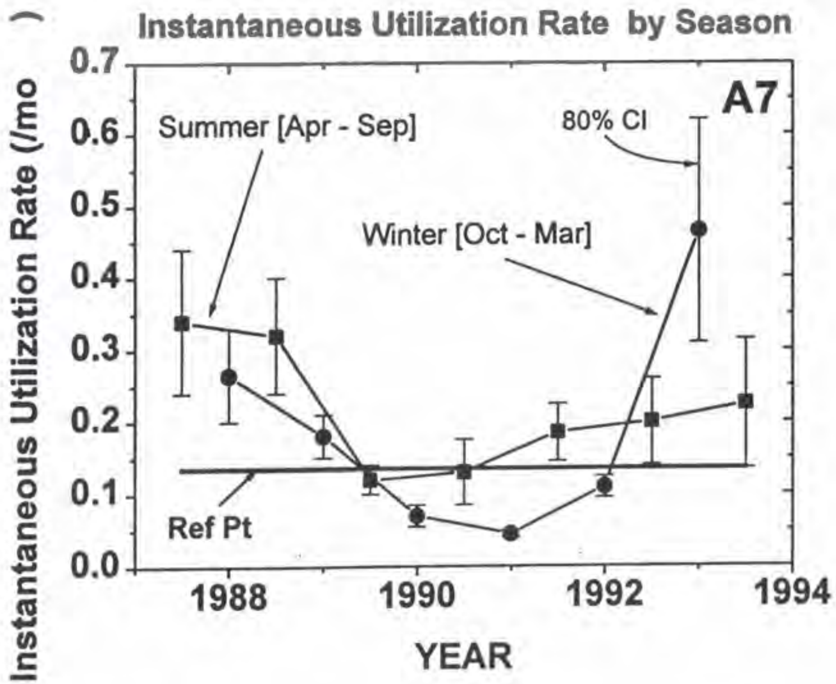
Long-Finned Squid



Long-Finned Squid







B. SHORT-FINNED (*Illex*) SQUID ADVISORY REPORT

State of Stock: The US portion of this transboundary stock is fully exploited and at a medium level of abundance. Since 1983, the domestic fishery has accounted for the majority of total landings and, since 1987, there has been no foreign participation in the *Illex* fishery within the EEZ. During 1991-1993, domestic landings averaged 15,900 mt and since 1988 have increased to a series high of 18,000 mt in 1993. Domestic fishing effort has also increased since 1988, reaching a near-record level in 1993. Concurrently, since 1988, LPUE has been gradually decreasing. Fishing mortality rates have increased every year since 1988 and are currently above the $F_{50\%}$ target level. Stock biomass appears to be stable, but has shown some decline since 1989.

Management Advice: *Illex illecebrosus* is a highly migratory, transboundary species and a joint assessment between US and Canadian scientists is critical since the 1980 collapse of the *Illex illecebrosus* fishery, in NAFO Subareas 3 and 4 (Canadian waters), suggests that high catch rates may lead to a prolonged absence of fishable stock. The overfishing definition for this stock should reflect its one-year life cycle. An appropriate threshold for this species would be a monthly $F_{20\%}$ (0.28) (Figure B3), with a monthly fishing mortality rate target of $F_{50\%}$. (0.11). Provisional estimates of long-term potential yield (LTPY) 14,579 mt (50% CI: 10,754 - 23,237 mt) for the $F_{50\%}$ target and 21,325 mt (50% CI: 18,150 - 28,183) for the $F_{20\%}$ threshold. These LTP estimates are consistent with recent resource productivity, but could vary depending on the favorability of environmental conditions for recruitment and growth. Landings in excess of the threshold may jeopardize the stock and fishery.

Forecast for 1995: No forecasts were made.

Landings and Status Table (weights in '000 mt): Short-finned Squid

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	Max	Min	Mean
Domestic Landings[2]	5.9	9.9	9.5	5.0	5.2	10.3	2.0	6.8	11.3	11.9	17.8	18.0	18.3[*]	18.3	0.1	4.0
Foreign Landings[3]	12.4	1.8	0.7	1.1	0.3	0	0	0	0	0	0	0	0	24.7	0.8	9.9
Total US Landings[2]	18.3	11.7	10.2	6.1	5.4	10.3	2.0	6.8	11.3	11.9	17.8	18.0	18.3[*]	24.9	0.4	10.8
Discards	Discards occur but reliable estimates not available															
Catch used in assessment[4]	18.3	11.7	10.2	6.1	5.4	10.3	2.0	6.8	11.3	11.9	17.8	18.0	na	18.3	2.0	10.8
Pre-recruits, Fall[5],millions	0.71	0.16	0.32	0.19	0.26	0.89	0.43	1.04	0.61	0.23	1.78	0.15	0.22	3.98	0.04	0.74
Biomass, Fall kg/tow[5]	0.6	0.2	0.5	0.4	0.3	1.8	3.5	1.6	2.3	0.7	0.8	1.7	0.9	9.0	0.1	1.9
Standardized Trawl Effort[4]	474	497	181	244	120	153	29	103	362	218	386	390	na	497	29	263.0
Standardized Trawl LPUE[4]	38.5	23.6	56.4	24.8	45.2	66.9	67.7	65.8	31.2	54.7	46.2	46.2	na	67.7	23.6	47.3

[1]Landings estimates for 1994 are preliminary.
[2]Min, max, mean for 1963-94.
[2]Min, max, mean for 1965-86.
[4]Min, max mean for 1982-93.
[5]Min, max, mean for 1967-94.

Stock Distribution and Identification: The *Illex illecebrosus* population is assumed to constitute a unit stock throughout its range of commercial exploitation from Cape Hatteras to Newfoundland. However, 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, lives for up to one year. NEFSC autumn research surveys indicate that synchronous fluctuations in *Illex* relative abundance occurred across broad geographic regions within the survey area during 1967-1993 and suggest that *Illex* recruitment, from Cape Hatteras to the Gulf of Maine, is affected by similar processes.

Catches: During 1973-1982, total landings (NAFO Subareas 2-6) averaged 71,000 mt and were predominately taken from Subareas 2-4 (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. 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 B1). Since 1987, there has been no foreign participation in the *Illex* fishery within the US EEZ. Domestic landings have been increasing since 1988, reaching a record high in 1993 of 18,000 mt. Preliminary estimates for 1994 landings are 18,300 mt.

Data and Assessment: *Illex illecebrosus* was last assessed in 1993 at SAW-17 (NEFSC, 1994). The current assessment relies primarily on standardized commercial effort and landings per effort data. Effort and LPUE values presented above differ from those reported for SAW-17 because the current assessment is based on a redefined set of trips that target *Illex* and better characterize the US EEZ fishery. In addition, estimates of biomass and fishing rates were produced from a surplus production model. A new yield per recruit analysis, based on a one-year life cycle and new life history information, was also completed. The spring and autumn NEFSC research survey indices of abundance were not directly used in this assessment. Based on limited information, discarding is likely minimal.

Biological Reference Points: Ensuring adequate spawning stock biomass is of primary importance in the management of annual species with highly variable interannual recruitment. The SARC selected $F_{20\%}$ as a threshold fishing mortality rate and $F_{50\%}$ as a target rate for this species. Monthly biological reference points were calculated based on an analysis of recently developed growth and maturity data. $F_{20\%}$ was computed as 0.28 and $F_{50\%}$ as 0.11 (Figure B3).

Fishing Mortality: Monthly fishing mortality rates ranged from a low of 0.01 in 1988 to a high of 0.13 in 1982 (Figure B2). There was a general decline in exploitation during 1982-1988 and a subsequent gradual increase to a current high of $F = 0.12$ in 1993. The probability that F_{93} exceeded $F_{50\%}$ is 0.54.

Recruitment: In contrast to SAW-17, survey indices presented in the **Landings and Status Table** reflect the weight and number per tow indices standardized to the fishing power of the two research vessels (Figure B4). Survey indices, however, are generally unsatisfactory in tracking recruitment due to the wide ranging distribution of the *Illex* stock.

Stock Biomass: Stock biomass in the US EEZ at the beginning of each fishing season increased from a low of roughly 25,000 mt in 1982 to over 35,000 mt during 1986-1989 (Figure B4). Since 1989, biomass has declined and was 29,600 mt in 1993.

Special Comments: Additional research on the utility of research survey indices for predicting recruitment should be conducted. The moderate significance of time of day on survey pre-recruit versus recruit catch rates should be further examined to determine whether diurnal correction factors should be applied to survey indices.

Real-time management of *Illex* would permit in-season adjustments via catch or effort limitations. Such adjustments would ensure preservation of an adequate level of spawning biomass each year, avoidance of overfishing during periods of poor recruitment, and increased landings during periods of good recruitment. A summary of the potential components of a real-time management plan, similar to that implemented in the Falkland Islands for *Illex argentinus*, is presented in Table B1.

Sources of Information: Report of the 21st Northeast Regional Stock Assessment Workshop, Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 96-05d); Report of the 17th Northeast Regional Stock Assessment Workshop, Stock Assessment Review Committee (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 94-06); Hendrickson et al, 1996, Stock Assessment of Northern Short-finned squid, *Illex illecebrosus*, in the Northwest Atlantic during 1993 (NEFSC Ref. Doc. 96-05g).

Table B1. Summary of results of a preliminary analysis of real-time management for *Illex illecebrosus*.

COMPONENT	APPROACH	EVALUATION
Set Target	Biological reference point	Rigorous justification may be difficult.
	Avoid in-season closure	May be favored by industry if interannual variability is reduced.
Set Threshold (to avoid)	Spring survey index	Not useful.
	Leslie-Delury models	LPUE patterns useful for 7 of 12 years. Finer temporal scale (weeks) might clarify problems. Agreement with current surplus production model (same magnitude).
	Fall survey index	Promising, but need improved analytical model (constraints).
	Indirect approach	Markov-type approach for estimating probability of meeting recruitment targets. Needs simulation study.
In-season Adjustments: Decision to Act	Delury estimator	** Limited data at present. Should improve with weekly LPUE data collection.
	Monthly LPUE vs later survey	Prediction of autumn survey index from June LPUE may work for Class 4 vessels.
In-season Adjustment: How to do it	Reduce TAC	
	Reduce effort	Used in Falkland Islands, but controversial.
Post Season Assessment	Surveys	Autumn survey may be useful.

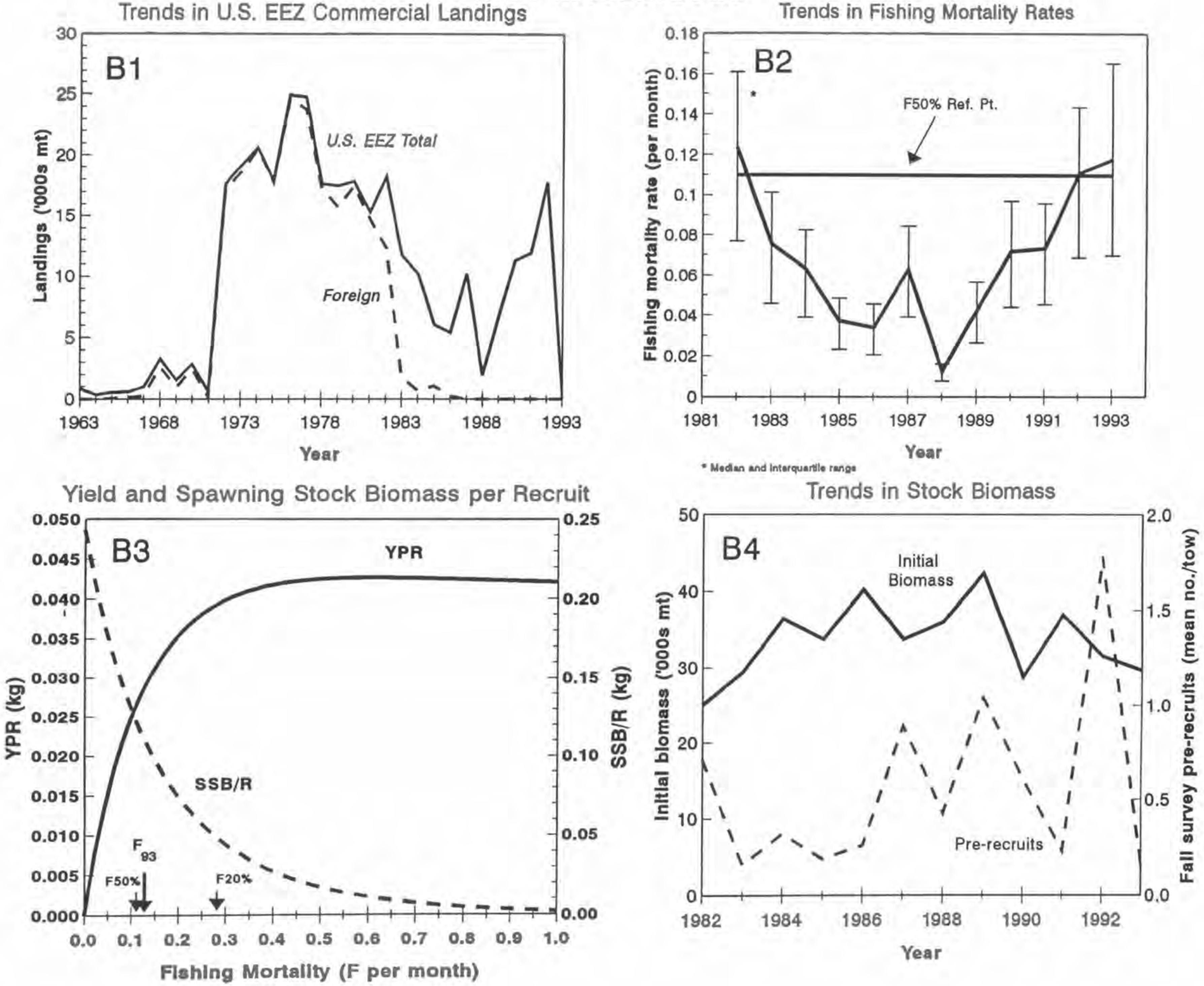
** Requirements for catch and effort data collection:

- By individual vessel
- Daily (though weekly or 10-day period may be adequate)
- By fishing area (e.g. 3-digit statistical area)
- Total removals (catch + discards)
- One or more measures of effort (e.g. hours jigged, days fished).

Requirements for weekly biological data collection, by at-sea observers, on selected vessels:

- Length frequency of the catch (usually by sex)
- Weight-length sub-samples (usually by sex) *{Essential!}*
- Sexual maturity
- Sex ratio

Illex illecebrosus



C. ATLANTIC HERRING ADVISORY REPORT

State of Stock: The stock is at a high biomass level and is under exploited. In 1994, estimates of fishing mortality rate decreased to a record-low of 0.03 (Figure C1), while spawning stock biomass increased to a record-high of 2.2 million mt (Figure C2). Fishery-independent abundance indices continue to suggest the stock complex is increasing in size and that the Georges Bank spawning grounds have been reoccupied.

Management Advice: Increased fishing on the stock complex, especially on Georges Bank, Southern New England, and off the Mid-Atlantic states, is encouraged. Evidence from analyses of spawner and recruit relationships and trends in mean weight at age of herring suggests that compensatory effects are slowing stock reproduction and growth. Therefore, over the short term, the stock could be fished at a higher rate than current levels. Due to uncertainties in the estimates of fishing mortality and spawning stock biomass, catch should be increased incrementally to facilitate a systematic evaluation of the impact on SSB. Since this stock complex is composed of several distinct spawning stocks, it is critical that these individual units not be locally depleted by over exploitation. If landings increase dramatically, the stock should be carefully monitored.

Forecast Table for 1995-1996: Quantitative forecasts of landings and spawning stock biomass under three hypothetical management regimes for 1995-1996 were simulated: status quo or F_{94}, $F_{0.1}$, and $F_{20\%}$. With annual recruitment assumed equivalent to the average of the last five years, none of the fishing mortality levels caused a decline in 1996 SSB below 1994 levels (Figure C4). Landings in 1996 ranged from approximately 250,000 mt to over 1 million mt for the range of simulated fishing mortalities. These analyses suggest that, over the short term, high landings will have little impact on SSB.

Forecasts for 1955 SSB and 1996 SSB and landings (in thousands of mt). 1994 SSB = 2.16 mmt.

Fishing mortality rate	SSB (1995)	Landings (1996)	SSB (1996)
Status quo F = 0.025	3,000	120	4,200
$F_{0.1}$ = 0.20	2,800	800	3,400
$F_{20\%}$ = 0.34	2,600	1,200	2,800

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

Year	1987	1988	1989	1990	1991	1992	1993	1994	Max[1] (1967-1994)	Min (1967-1994)	Mean (1967-1994)
US Commercial Landings	39.7	41.1	53.0	63.0	54.7	59.7	54.7	48.1	414.9	25.0	120.5
Canada Commercial Landings	27.3	33.4	44.1	38.8	24.6	32.0	31.6	22.2	44.1	8.7	26.4
Discards[2]	0.1	0.3	0.7	1.4	0.9	0.0	0.0	0.0	1.4	0.0	0.2
Catch used in Assessment	67.1	74.8	97.8	103.2	80.2	91.7	86.3	70.3	448.1	36.5	147.1
Spawning Stock Biomass	245	278	337	479	796	1204	1853	2159	2159	21	395
Recruitment (Age 1)	5.1	7.2	10.1	14.2	11.9	7.0	23.0	29.8	29.8	0.4	3.2[3]
Mean F (Age 3-7)	0.13	0.12	0.20	0.13	0.06	0.04	0.03	0.03	1.11	0.03	0.48
Exploitation Rate	11%	10%	16%	11%	5%	4%	3%	3%	62%	3%	35%

[1]New Brunswick fixed gear landings only. [2]From joint venture operations. [3]Geometric mean.

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

Catches: Commercial landings were at their highest levels during the 1960s and 1970s during the period of the offshore fishery for herring on Georges Bank (exceeding 400,000 mt in 1968). After the Georges Bank spawning stock collapsed, landings for the stock complex leveled off between 50,000 and 100,000 mt per year throughout the 1980s to the present (Figure C1). Most of the harvest is currently taken from the coastal waters of the Gulf of Maine.

Data and Assessment: An analytical assessment (VPA-ADAPT methodology) of commercial landings at age and discards was adopted by the SARC. Catch data from US commercial fisheries, New Brunswick (Canada) fixed-gear fisheries, distant-water fleets, IWP, and discards from US mackerel JV fisheries were used to develop the catch-at-age matrix. Mean weight was determined from US coastal fisheries only. Information on abundance and size of the spawning stock was taken from NEFSC spring survey catch per tow disaggregated by age and from a regionally weighted index of larval herring abundance. An alternate VPA method (ICA) was investigated for use in future herring assessments.

Biological Reference Points: Biological reference points for herring are based on a separable VPA-estimated exploitation pattern which indicated that $F_{0.1} = 0.20$ (16% exploitation), $F_{max} = 0.40$ (30% exploitation), and $F_{20\%} = 0.34$ (26% exploitation) (Figure C3). The SARC recommended development of stock size biological reference points, such as target spawning stock size and a minimum biologically acceptable level (MBAL) for the coastal stock complex.

Fishing Mortality: Fishing mortality exceeded 0.75 (48% exploitation) for a number of years immediately after the stock collapse of the 1970s. However, F has been less than 0.1 (9% exploitation) for the past four years (Figure C1). Current fishing mortalities are well below all mortality reference points. Mean F for ages 3 - 7, in 1994, was estimated to be 0.03 (3% exploitation). Given the uncertainty in the estimates of F, there is a 90% probability that the 1994 F was less than 0.034 (Figure C6).

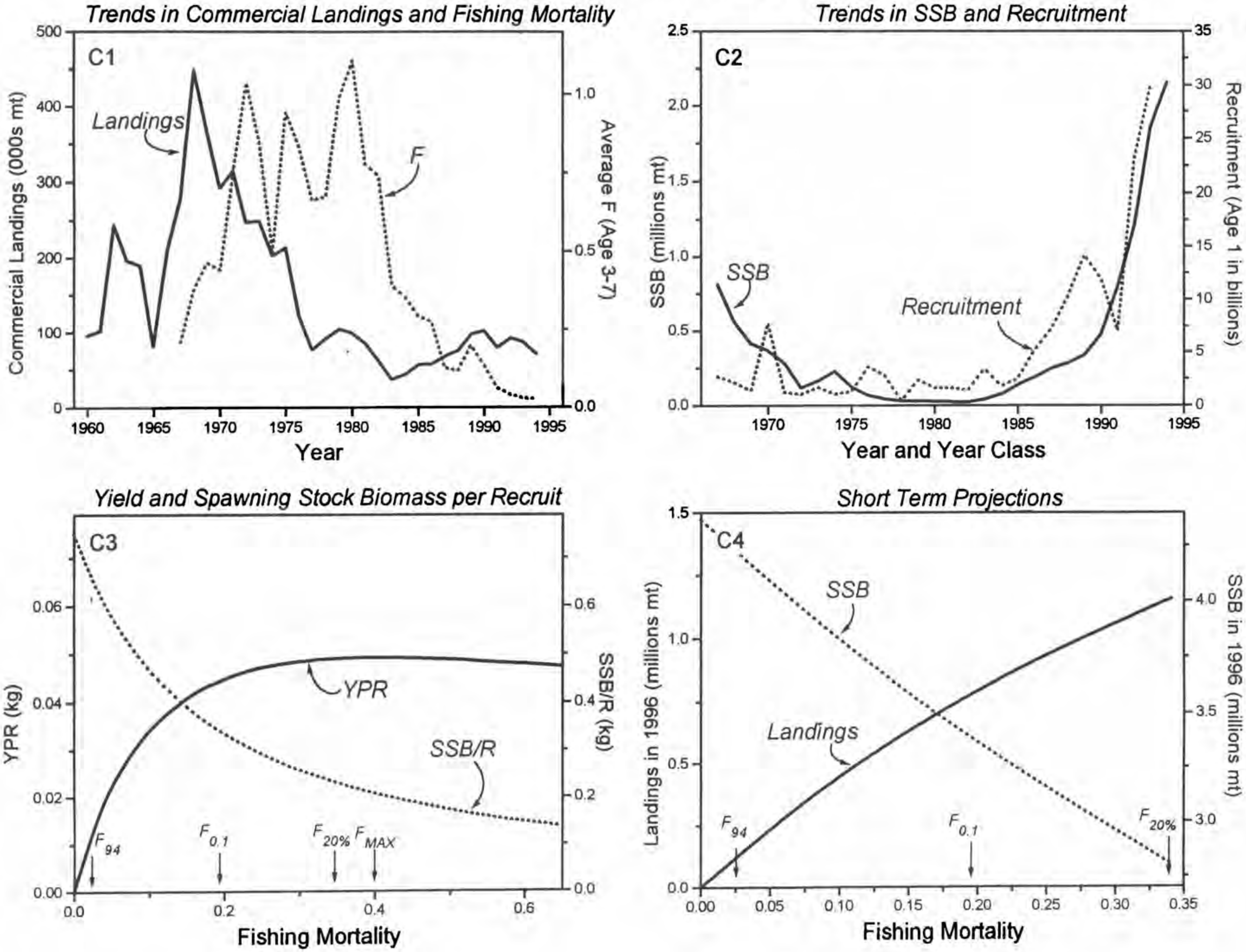
Recruitment: The trend of increasing recruitment that began in the 1980s has continued with recent year classes (Figure C2), although current estimates are imprecisely determined.

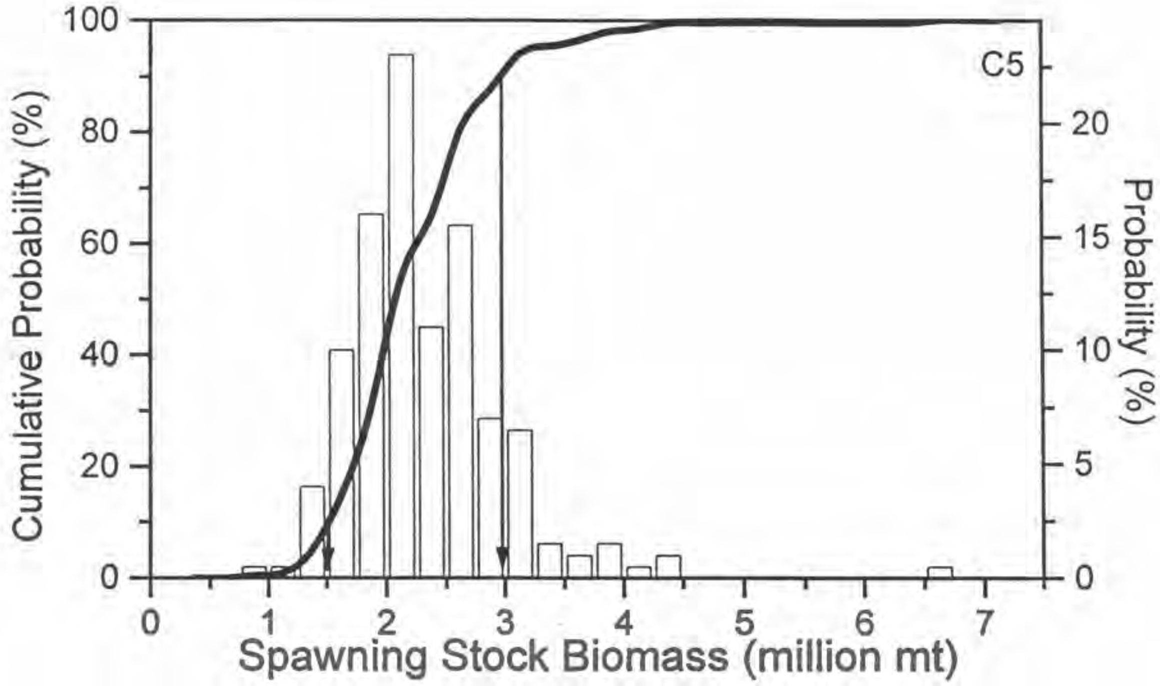
Spawning Stock Biomass: Spawning stock biomass (SSB) has increased in recent years to a record-high level of 2.16 million mt in 1994. Prior to collapse of the Georges Bank spawning stock, SSB of the complex was as high as 811,000 mt and may have been higher prior to the beginning of the assessment time series. If recruitment of the 1992 and 1993 year classes is as high as initially predicted, SSB should continue to increase. Accounting for the uncertainty in the estimates of the 1994 SSB, there is a 90% probability that it exceeds 1.5 million mt (Figure C5).

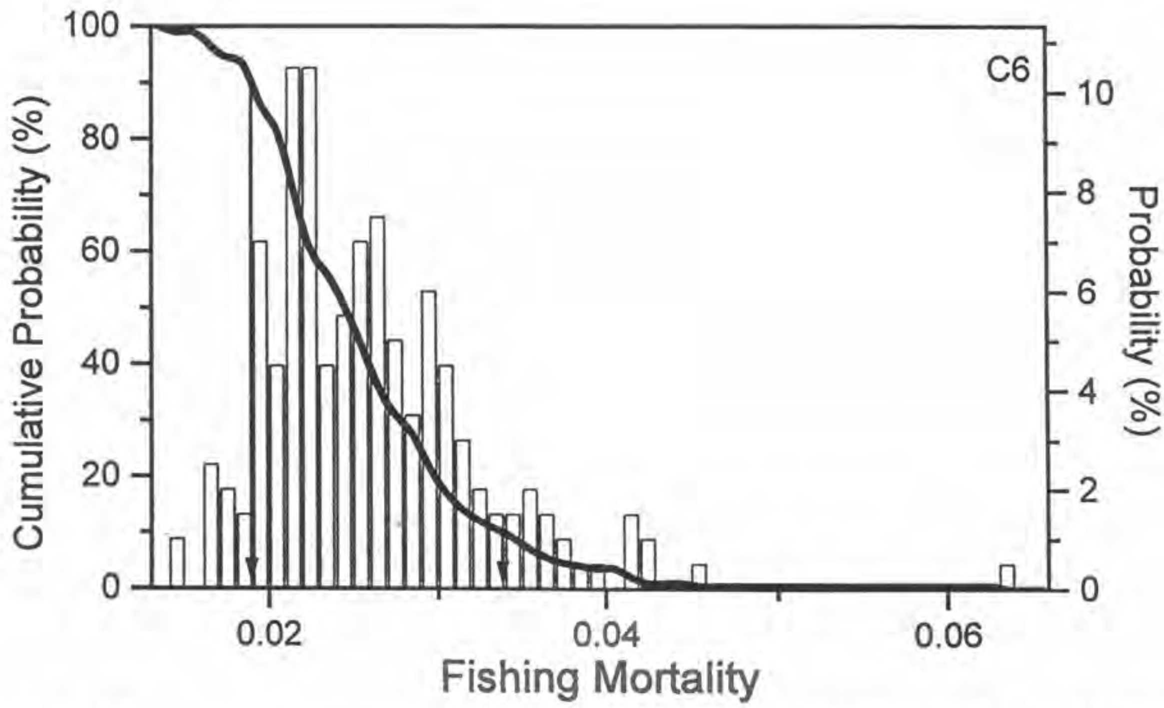
Special Comments: If the level of fishing mortality on the stock complex remains low, analytical assessments and the provision of advice should continue to be done biennially. The assessment and management advice for the herring coastal stock complex could be improved with 1) development of a survey designed specifically for assessing pelagic resources, 2) resolution of stock identification issues, 3) better tracking of weight data used in the assessment, and 4) examination of historical data from a variety of sources including former Eastern Bloc resource agencies. The current assessment has produced low precision estimates of F and SSB due in part to the low fishing mortality currently being exerted on the stock complex. Because portions of the catch come from Canadian waters, a joint assessment by the two countries is recommended.

Source of Information: Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW), Stock Assessment Review (SARC) Consensus Summary of Assessments (NEFSC Ref. Doc. 96-05d).

Atlantic Herring-Coastal Stock Complex







Figures C5 and C6. Precision estimates of spawning stock biomass and fishing mortality of Atlantic herring in 1994. Vertical bars display both the range of the estimator and the probability of individual values within the range. The solid lines give the probability that F is greater or SSB is less than any selected value on the respective x-axis. The precision estimates were derived from 200 bootstrap replications of the ADAPT model.

D1. SOUTHERN NEW ENGLAND - MID-ATLANTIC WINTER FLOUNDER ADVISORY REPORT

State of Stock: The Southern New England - Mid-Atlantic stock is at a low level of biomass and is over exploited (F_{93} = 0.83, 51% exploitation rate, versus the ASMFC target of $F_{40\%}$ = 0.20, 17% exploitation rate). Fishing mortality rates since 1985 have generally been above 1.0 (58% exploitation). Spawning stock biomass has declined from 10,600 mt in 1985 to 3,800 mt in 1993. The time series of survey indices indicates that stock biomass in the late 1970s could have been two to three times larger than 1985 levels. Except for the 1992 year class, recruitment has declined continuously during 1985-1993.

Management Advice: Fishing mortality should be reduced immediately to the lowest possible level. Age at capture should be increased at least one full age (e.g., by a 1 inch increase in effective mesh size) to reduce exploitation of juvenile fish. Rebuilding of spawning stock biomass to previously observed higher levels is necessary to improve recruitment and increase landings.

Forecast Table for 1996-1997: $F_{94,95}$ = 0.83. Recruitment (age 1) in 1994-1997 was derived from an estimated stock-recruitment relationship combined with a 10% probability of obtaining recruitment equal to the 1992 year class. SSB was estimated to be 4,600 mt in 1994 and 7,800 mt in 1995. Likewise, landings were estimated to be 4,000 mt in 1994 and 6,000 mt in 1995.

Predicted Median Landings and Spawning Stock Biomass (thousands of mt)

Option	F_{96-97}	SSB (96)	Landings (96)	SSB (97)
A	F = 0.1	8.6	0.9	12.1
B	$F_{0.1}$ = 0.22	8.0	2.8	9.1
C	$F_{(sq)}$ = 0.83	7.5	5.3	6.1

<u>Consequences/Implications</u>

A. SSB increases above predicted 1995 level; landings initially decline to record-low level, but increase thereafter.
B. SSB increases above predicted 1995 level; landings initially decline to record low level, but increase thereafter.
C. SSB declines below predicted 1995 level; landings decline from predicted 1995 level.

Note: Additional forecasts that assumed substantially reduced selection of age 3 and 4 fish (and status quo F) resulted in a SSB trajectory intermediate between the $F_{0.1}$ and F_{sq} scenarios. Landings were initially reduced relative to the status quo, but exceeded those from the F_{sq} scenario after 1999.

Landings and Status Table (weights in '000 mt, recruitment in millions): Southern New England - Mid-Atlantic Winter Flounder

Year	1988	1989	1990	1991	1992	1993	1994	1995	Max	Min (1985-1993)	Mean
Commercial Landings	4.3	3.7	4.2	4.8	3.8	3.0	n/a	-	7.0	3.0	4.6
Commercial Discards	0.9	1.4	0.7	0.8	0.5	0.5	n/a	-	1.5	0.5	0.9
Recreational Landings	3.4	1.8	1.1	1.2	0.4	0.5	0.5	-	5.2	0.4	2.0
Recreational Discards	0.1	<0.1	<0.1	0.1	<0.1	<0.1	n/a	-	0.2	<0.1	0.1
Catch used in Assessment	8.7	6.9	6.0	6.9	4.7	4.0	n/a	-	14.0	4.0	7.8
Spawning stock biomass[1]	5.9	4.8	4.5	4.7	4.0	3.8	4.6[2]	-	10.7	3.8	6.1
Recruitment (Age 1)	26.8	23.2	17.2	14.6	15.0	39.4	11.4	11.5[2]	39.4	11.4	24.1[3]
Mean F (4-5,u)	1.4	1.2	1.1	1.3	1.1	0.8		-	1.4	0.6	1.1
Exploitation Rate	70%	65%	61%	67%	61%	51%	-	-	70%	41%	59%

[1]At beginning of the spawning season, mid-March. [2]Predicted or assumed. [3]Over period 1985-1994.

Stock Identification and Distribution: Winter flounder are distributed from Labrador to North Carolina. Localized stocks are found in coastal estuaries. Because the fishery exploits a mixture of these stocks, a stock complex was defined at this SARC, for assessment purposes, as the Southern New England-Mid-Atlantic stock complex which is distributed from the northern edge of Cape Cod south.

Catches: Total commercial landings peaked in 1966 at 12,000 mt and declined thereafter to 3,300 mt in 1976. Landings increased in the late 1970s and early 1980s to a peak of 11,000 mt in 198, but have since declined to a record low. Recreational landings declined from a peak of 5,700 mt in 1984 to 500 mt in 1994. Total catches (including discards) have declined from 15,000 mt in 1985 to 4,600 mt in 1993 (Figure D1-1). Commercial landings in 1994 were unavailable.

Data and Assessment: Winter flounder were last assessed in 1991 (SAW 13) using tagging data, survey abundance indices, and yield-per-recruit analyses. The current assessment represents the first analytical assessment (VPA) of 1985-1993 commercial and recreational catches (landings plus discard) for the combined SNE-MA region. Relative to earlier assessments, the natural mortality rate (M) was revised downward to 0.2, consistent with newly available data on the oldest ages present in the stock complex. Information on recruitment and stock abundance from NEFSC spring and autumn, Massachusetts spring, Rhode Island spring, and Connecticut spring trawl survey catch-per-tow-at-age data was used. In addition, recruitment indices were developed from surveys conducted by Massachusetts, Rhode Island, and Delaware.

Biological Reference Points: Yield and SSB per recruit analyses performed with an assumed M of 0.20 indicate that $F_{0.1} = 0.22$ (18% exploitation), $F_{40\%} = 0.21$ (17% exploitation), and $F_{20\%} = 0.46$ (34% exploitation) (Figure D1-3).

Fishing Mortality: During 1985-1993, the fishing mortality rate was high, varying between 0.5 and 1.4 (41-79% exploitation rate) and averaging 1.1 (59% exploitation) (Figure D1-1). Accounting for the uncertainty associated with the 1993 F estimates, there is an 80% probability that the 1993 F lies between 0.71 (47% exploitation) and 0.98 (57% exploitation) (Figure D1-6). There is a 100% probability that fishing mortality in 1993 exceeded $F_{0.1}$, $F_{40\%}$, and $F_{20\%}$.

Recruitment: Recruitment has declined continuously (Figure D1-2) from 36 million fish in 1985 to 11 million fish in 1993, with the exception of the large 1992 year class (presently estimated at 39 million fish). This year class is still present, based on 1995 survey results. Additional information on the size of the year class will be available when landings at age for 1994-1995 are estimated. Preliminary estimates from current survey indices indicate that the 1995 year class is below average (Figure D1-4).

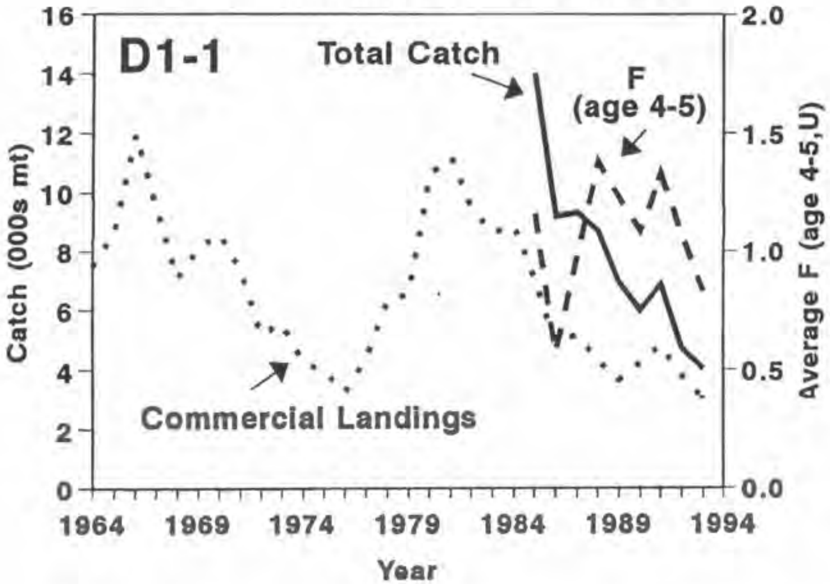
Spawning Stock Biomass: SSB declined by 65% between 1985 (10,700 mt) and 1993 (3,800 mt) to record-low levels (Figure D1-2). Accounting for the uncertainty associated with the 1994 SSB estimates, there is an 80% probability that the 1993 SSB was between 3,450 mt and 4,300 mt (Figure D1-5).

Special Comments: Additional investigation is needed to develop estimates of minimum biomass thresholds. A high proportion (86%) of recent landings are obtained offshore of state waters (0 - 3 miles).

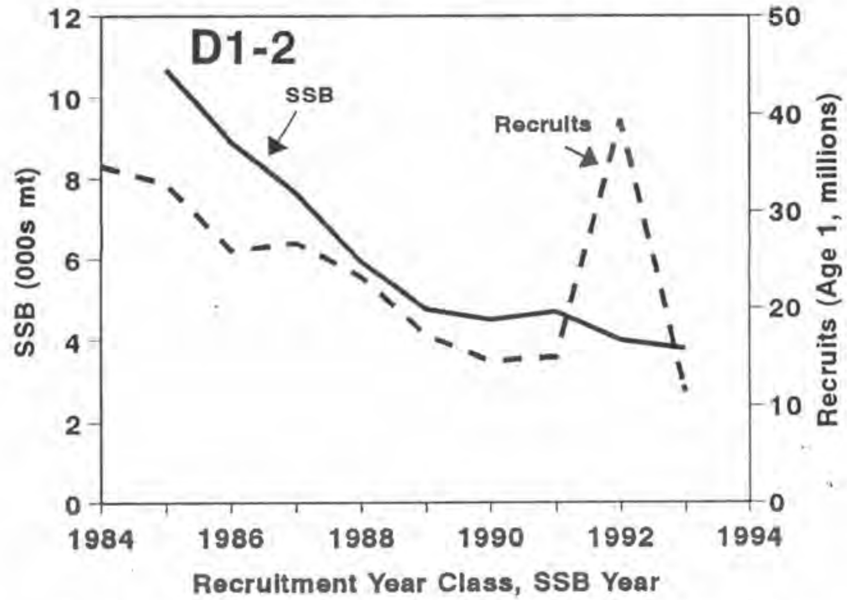
Source of Information: Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 96-05d; Shepherd, et al., 1996, Assessment of Winter Founder, *Pleuronectes americanus*, in Southern New England and the Mid-Atlantic NEFSC Ref. Doc. 96-05b.

Southern New England/Mid-Atlantic Winter Flounder

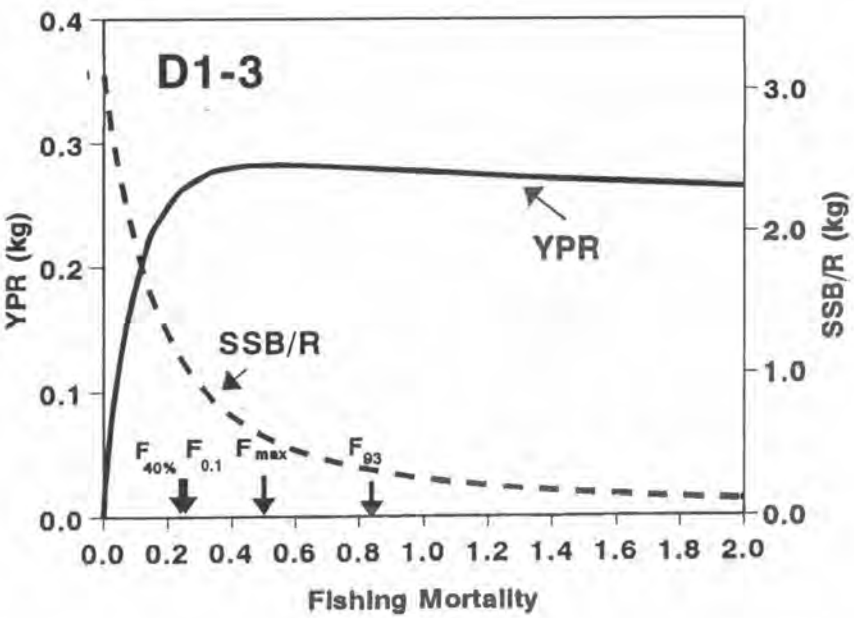
Trends in Commercial Landings, Total Catch and Fishing Mortality



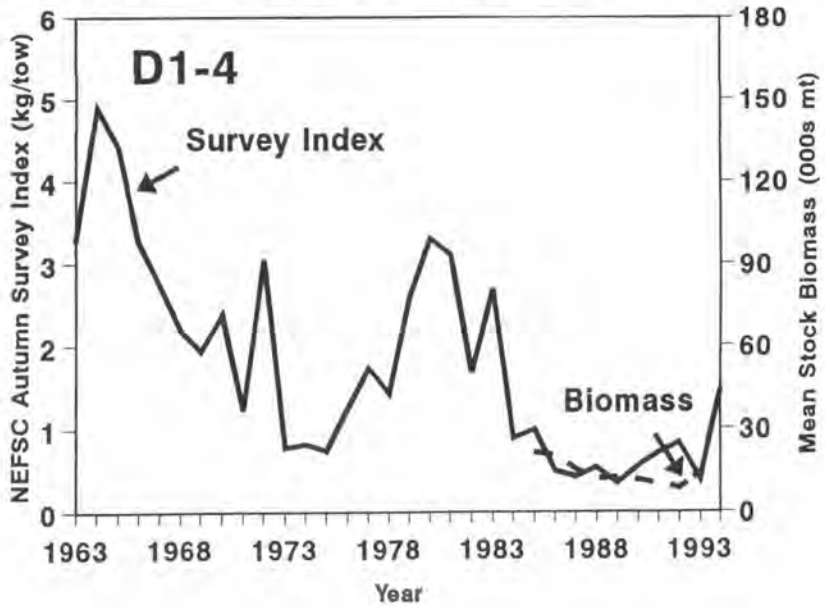
Trends in Stock Biomass and Recruitment



Yield and Spawning Stock Biomass per Recruit

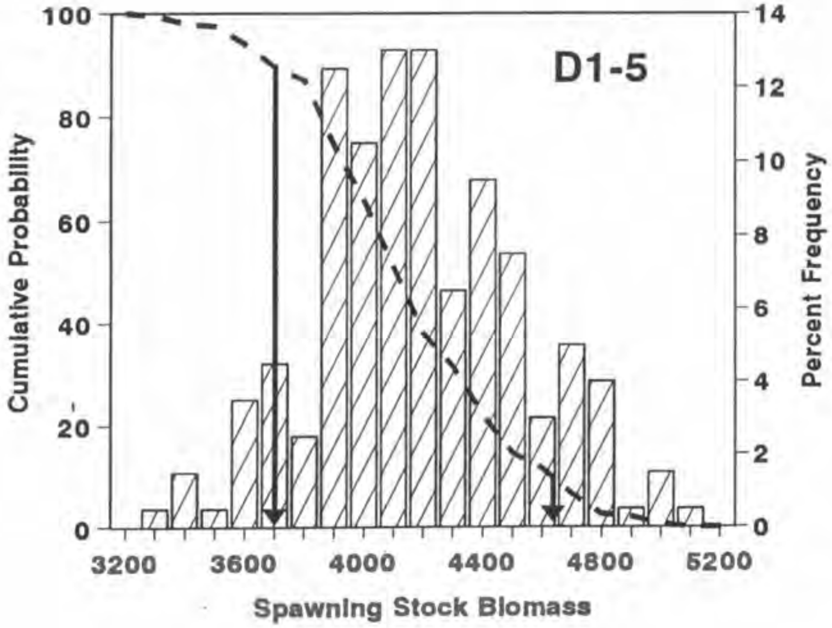


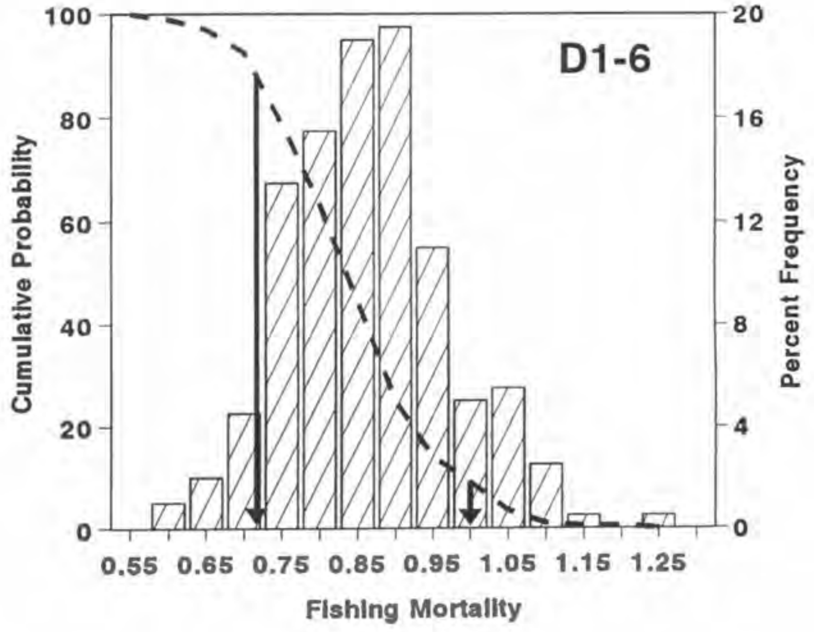
NEFSC Survey Indices and Stock Biomass (VPA)



Southern New England/Mid-Atlantic
Winter Flounder

Precision Estimates for SSB and Fishing Mortality





D2. GULF OF MAINE WINTER FLOUNDER ADVISORY REPORT

State of Stock: The Gulf of Maine winter flounder stock is at low level of biomass and is over exploited. Landings are at a record low. Survey indices and recreational LPUE have declined significantly since the early 1980s.

Management Advice: Fishing mortality should be reduced immediately over the range of the fishery and management should be at least as restrictive as that governing the states fishing under the ASMFC FMP.

Forecast: No forecasts were made.

Landings and Status Table (weights in '000 mt): Gulf of Maine Winter Flounder

Year	1988	1989	1990	1991	1992	1993	1994	Max (1979-1994)	Min (1979-1994)	Mean (1979-1994)
Commercial Landings	1.3	1.3	1.1	1.0	0.8	0.6	-	2.8	0.6	1.6
Recreational Landings	0.6	0.6	0.4	0.1	0.1	0.1	-	2.6	0.1	1.1
Total Landings	1.9	1.9	1.5	1.1	0.9	0.7	-	5.0	0.7	2.6
Biomass Index[1]	0.7	0.4	0.6	0.4	0.4	0.1	0.3	2.6	0.1	0.8
Mean F(4-7,w)[2]	0.7	1.1	1.0	1.2	0.9	2.0	1.2	2.2	0.3	1.2
Exploitation Rate	49%	63%	60%	65%	54%	81%	65%	83%	26%	65%

[1]NEFSC Spring Survey (kg/tow). [2]Derived from Mass. Spring Age-1 (number/tow).

Stock Identification and Distribution: Gulf of Maine winter flounder are distributed from Cape Cod to Nova Scotia, in estuaries and coastal waters out to 30 fathoms. Although there may be separate estuarine spawning groups in the Gulf of Maine, the entire stock complex is considered a single management area. The bulk (87%) of recent landings have been caught beyond three miles.

Catches: Annual commercial landings were approximately 1,000 mt in the 1960s and early 1970s, gradually increased to a maximum of 2,800 mt in 1982, and decreased to a record-low of 600 mt in 1993 (Figure D2-1). Recreational landings peaked at 2,600 in 1981 and declined to 131 mt in 1993.

Data and Assessment: The stock was last assessed in 1992 (SAW-14). In the absence of catch-at-age information, a preliminary index-based assessment was performed. Massachusetts survey indices of abundance at age were used to derive fishing mortality estimates, assuming a natural mortality rate of $M = 0.2$.

Biological Reference Points: Biological reference points for this stock complex were not updated from those presented at SARC 14 (1992). Previously estimated reference points were $F_{msy} = 0.60$ (41% exploitation) and $F_{25\%MSP} = 0.79$ (50% exploitation).

Fishing Mortality: Provisional estimates of 1978-1993 fishing mortality (Figure D2-1) ranged from 0.3 to 2.2 (26-83% exploitation). F has remained near or above 1.0 since 1989, well in excess of all existing reference points.

Recruitment: Indices of recruitment are not currently available.

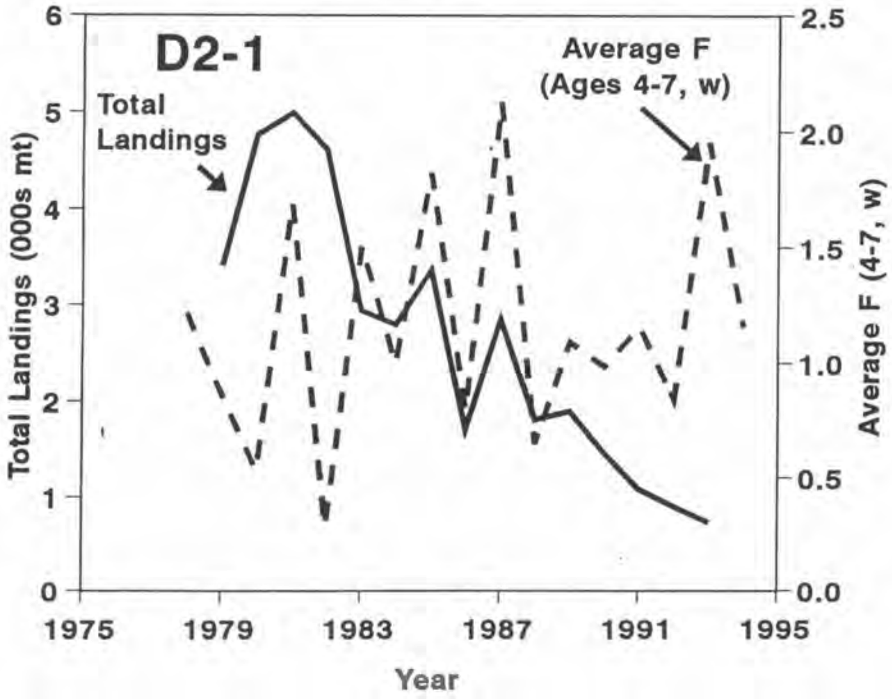
Stock Biomass: Although total biomass was not estimated, the NEFSC spring biomass index peaked in 1981 and declined to 10% of peak levels in recent years (Figure D2-2).

Special Comments: Since 1979, mean individual weights from several surveys have significantly declined, suggesting a shift in distribution to smaller size fish.

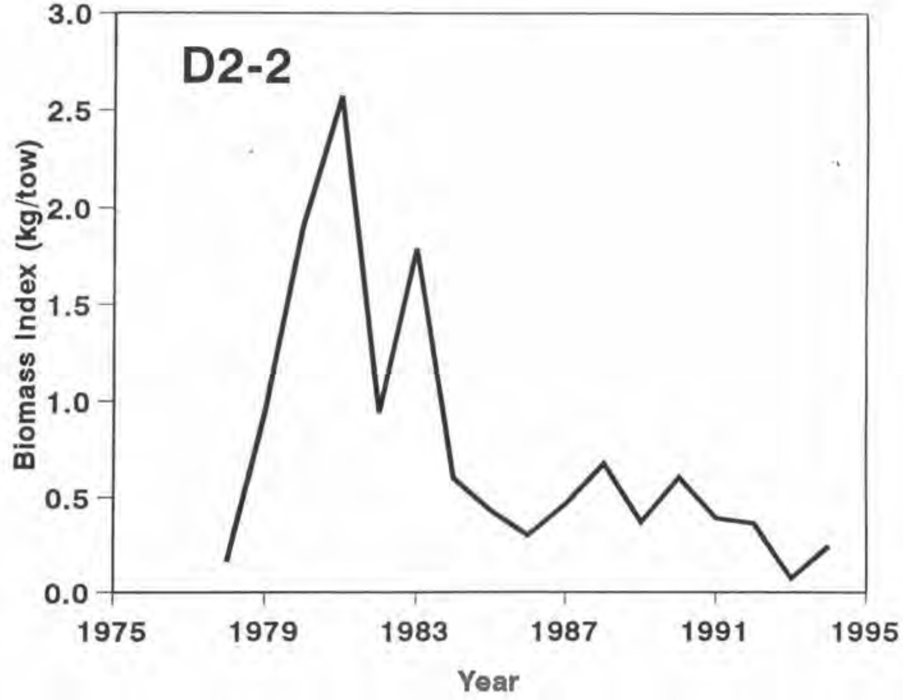
Source of Information: Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC Ref. Doc. 96-05d; S. Cadrin, et al., 1996, An Index-Based Assessment of Winter Flounder, *Pleuronectes americanus*, Populations in the Gulf of Maine, NEFSC Ref. Doc. 96-05a; Report of the 14th Northeast Regional Stock Assessment Workshop (SAW 14), NEFSC Ref. Doc. 92-07.

Gulf of Maine
Winter Flounder

Trends in Total Landings and Fishing Mortality



Trends in Stock Biomass



E. NORTHEAST DEMERSAL COMPLEX ADVISORY REPORT

State of Stocks: Of the 25 stocks examined, 18 (72%) have exhibited significant declines in biomass over the last 10-15 years (Table E1). The biomass of 13 of these stocks is at or near record-low levels; the biomass of five other stocks remains well below historic levels. The 18 stocks include traditional groundfish species such as cod, haddock, pollock, and yellowtail flounder, as well as other less traditional species such as cusk, wolffish, and ocean pout (Table E2, Figure E5). Only two stocks, the northern stocks of red and silver hake, have exhibited consistent increases in biomass over the past decade.

Biomass of principal groundfish (cod, haddock, pollock, white hake, and redfish) has declined in all regions by about 70-80% since the mid-1960s (Table E2, Figures E1-E4). The principal flounder biomass (yellowtail flounder, American plaice, witch flounder, winter flounder, and windowpane flounder) has also declined by about 60-80% since the late 1970s (Table E2, Figures E1-E4). The decline in biomass for other groundfish (cusk, wolffish, and goosefish) has been equally severe as that for the principal groundfish group, with biomass indices decreasing by about 80 % since the mid-1970s (Table E2, Figures E1-E4). In contrast, the biomass of small-mesh species (silver hake, red hake, and ocean pout) has increased approximately 2- to 4-fold over the past two decades (Table E2, Figure E1-E4). Overall, the biomass of the 16 species comprising the complex is about 30% of the biomass estimated during the late 1970s.

Gulf of Maine: Biomass levels of cod, pollock, witch flounder, cusk, and wolffish have declined by about 80-90%, and haddock biomass has declined to nearly undetectable levels over the past two or three decades. American plaice and redfish biomass increased slightly from record-low levels in the mid-1980s, but currently remain at about 50% and 30% of their respective levels during the 1970s (Figure E4).

Georges Bank: Cod, haddock, yellowtail flounder, and winter flounder biomass has declined by about 80-90% over the past two or three decades. During the same period, silver hake and red hake biomass has increased 4-fold on northern Georges Bank and in the Gulf of Maine (Figure E4).

Southern New England: Yellowtail flounder biomass has declined by over 90%, winter flounder biomass has declined by about 80%, and ocean pout biomass has declined by about 60-70% over the past two or three decades. During the same period, silver hake and red hake biomass levels have declined by about 50% in the Southern New England-Georges Bank-Middle Atlantic region (Figure E4).

Management Advice: Persistent high rates of exploitation (Table E3) have caused significant and widespread declines in biomass of species commonly targeted by the large-mesh demersal fisheries. Changes in areal distribution are also evident, indicating possible compensation by some species in order to remain within preferred depth and temperature ranges. Haddock now appear to be concentrated primarily on the Northeast Peak of Georges Bank (Figures E5 and E6), and the effects of this highly concentrated distribution may have implications on the catchability of haddock in commercial fisheries. Annual changes in environmental conditions may influence annual variability in biomass indices, but the overall declining trends due to fishing, noted for most stocks comprising the Northeast Demersal Complex over the past two or three decades, have persisted during intervals when bottom temperature was both higher and lower than the long-term mean.

Almost all species comprising the Demersal Complex are at or near historic low levels of biomass in the Gulf of Maine, on Georges Bank, and off Southern New England. There is no potential resource capacity in the other groundfish stocks (i.e., cusk, wolffish, and goosefish) to absorb additional effort which may be shifted from targeting principal groundfish.

Immediate, comprehensive, and substantial reductions in fishing mortality are required for all large-mesh species subject to exploitation. Further, the current low biomass levels for most species in the Northeast Demersal Complex suggest that sustained reductions in fishing mortality will be required to restore the complex to former biomass levels.

Data and Assessment: NEFSC and Commonwealth of Massachusetts research vessel bottom trawl survey data were analyzed for trends in biomass by species and stock and in aggregate for four species groups. Additional analyses were developed to examine habitat preference, spatial variability, concentration effects, and relationship between survey indices and VPA estimates of mature biomass.

Special Comments: In some cases, it is possible to accurately predict total mature biomass from research vessel survey mature biomass indices (see Cadrin and Mayo, CRD 96-xx). This predictive capability is useful in cases where catches become unavailable.

Source: Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW), Consensus Summary of Assessments NEFSC CRD 96-05d; Sosebee, K. and S. Cadrin, Abundance and Biomass Indices for Northeast Demersal Complex Stocks from NMFS and Massachusetts Inshore Bottom Trawl Surveys, NOAA Technical Memorandum, in press.

Table E1. Current classification of Northeast Demersal Complex stocks by biomass level and exploitation status.

EXPLOITATION STATUS	BIOMASS LEVEL: Low	Medium	High
Under exploited	Red hake - South	Red hake - North	
Fully exploited	Pollock Ocean pout	White hake Silver hake - North	
Over exploited	Cod - GM Cod - GB Haddock - GM Haddock - GB Redfish Wolffish Cusk Goosefish Silver hake - South Yellowtail flounder - GB Yellowtail flounder - SNE Yellowtail flounder - CC Witch flounder American plaice Winter flounder - GM Winter flounder - GB Winter flounder - SNE Windowpane - North Windowpane - South		

Table E2. Biomass trends of the Northeast Demersal Complex.

	Principal Groundfish	Principal Flounders	Small-Mesh Groundfish	Other Groundfish
Gulf of Maine	80-90% decline in cod, haddock, and pollock	80-90% decline in witch flounder		80-90% decline in cusk and wolffish
Georges Bank	80% decline in cod and haddock	80% decline in yellowtail and winter flounder		80% decline in goosefish
Southern New England		60-90% decline in yellowtail and winter flounder	60-90% decline in ocean pout	60-90% decline in goosefish
Overall	70-80% decline since mid-1980s	60-80% decline since late 1970s	2- to 4-fold increase since 1970s	80% decline since mid-1970s

Note: Principal groundfish are: cod, haddock, pollock, white hake, and redfish.
Principal flounders are: yellowtail flounder, American plaice, witch flounder, winter flounder, and windowpane flounder.
Small mesh groudfish are: silver hake, red hake, and ocean pout.
Other groundfish are: cusk wolffish, and goosefish.

Table E3. Most recent fishing mortality (F) estimates and overfishing F for Northeast Demersal Stocks.

Stock	Most Recent F (year)	Overfishing F
Cod - Gulf of Maine	0.93 (1993)	0.35
Cod - Georges Bank	0.91 (1993)	0.36
Haddock - Gulf of Maine	N/A	0.35
Haddock - Georges Bank	0.29 (1994)	0.35
Redfish	N/A	0.12
Pollock	0.72 (1992)	0.65
White Hake	0.42 (1993)	N/A
Silver Hake - North	N/A	0.36
Silver Hake - South	N/A	0.38
Yellowtail Flounder - Georges Bank	1.20 (1993)	0.58
Yellowtail Flounder - Southern New England	2.30 (1992)	0.49
American Plaice	0.62 (1991)	0.49
Witch Flounder	0.45 (1993)	0.39
Winter Flounder - Gulf of Maine	1.20 (1994)	0.79
Winter Flounder - Georges Bank	N/A	0.48
Winter Flounder - Southern New England	0.83 (1993)	0.20

Note: No estimates of recent or overfishing fishing mortality rates exist for worlffish, cusk, ocean pout, goosefish, red hake, Cape Cod yellowtail flounder, Gulf of Maine/Georges Bank windowpane flounder, and Southern New England/MA windowpane flounder.

Gulf of Maine

NEFSC Autumn Survey and Massachusetts Spring Survey

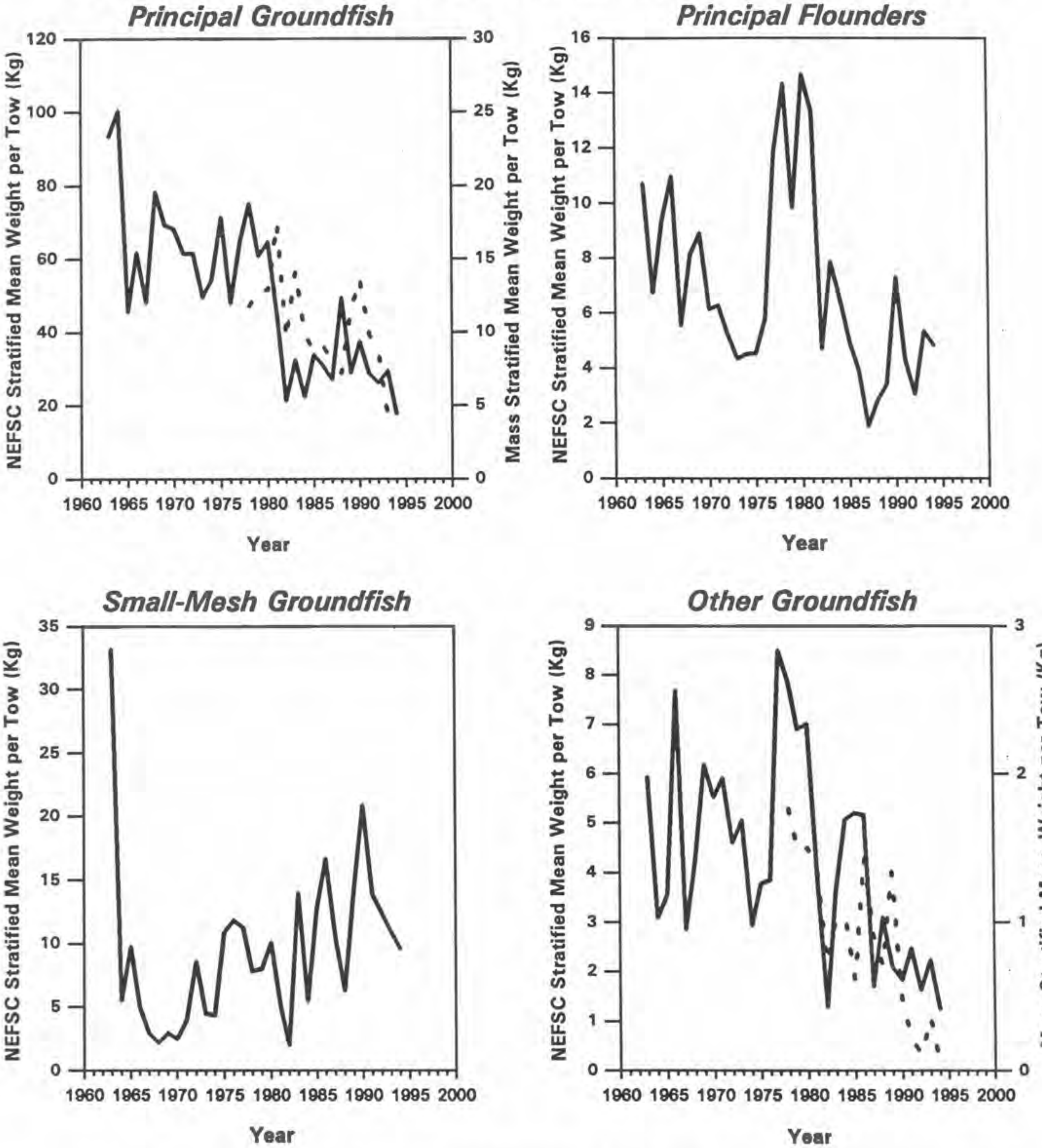


Figure E1. Biomass of principal groundfish (Atlantic cod, haddock, pollock, redfish, and white hake), principal flounders (yellowtail flounder, American plaice, witch flounder, winter flounder, and windowpane flounder), small-mesh groundfish (silver hake, red hake, and ocean pout), and other groundfish (wolffish, goosefish, and cusk) in the Gulf of Maine. Results are from NEFSC autumn offshore (solid line) and Massachusetts spring inshore (dashed line) research vessel bottom trawl surveys.

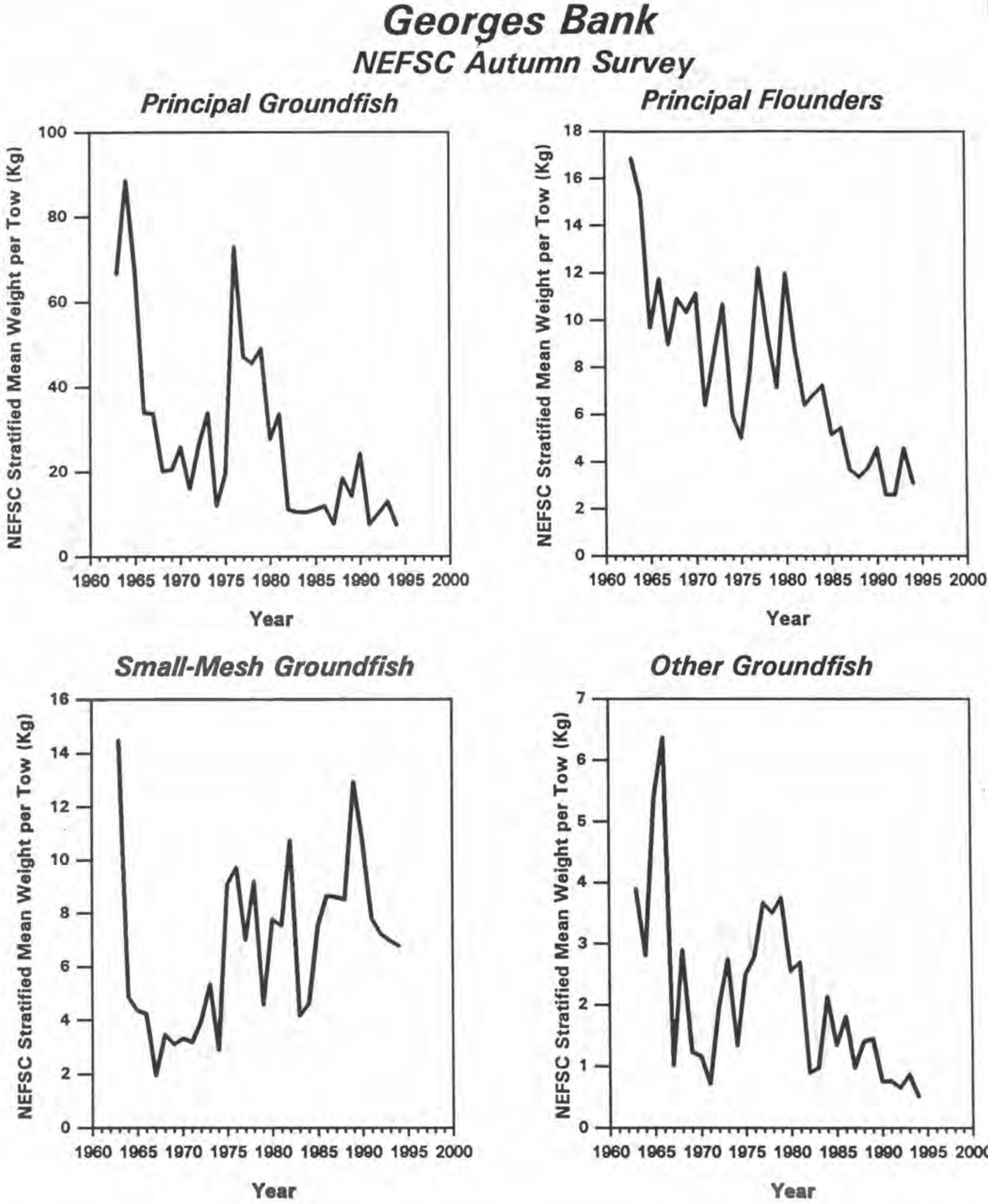


Figure E2. Biomass of principal groundfish (Atlantic cod, haddock, pollock, redfish, and white hake), principal flounders (yellowtail flounder, American plaice, witch flounder, winter flounder, and windowpane flounder), small-mesh groundfish (silver hake, red hake, and ocean pout), and other groundfish (wolffish, goosefish, and cusk) on Georges Bank. Results are from NEFSC autumn offshore research vessel bottom trawl surveys.

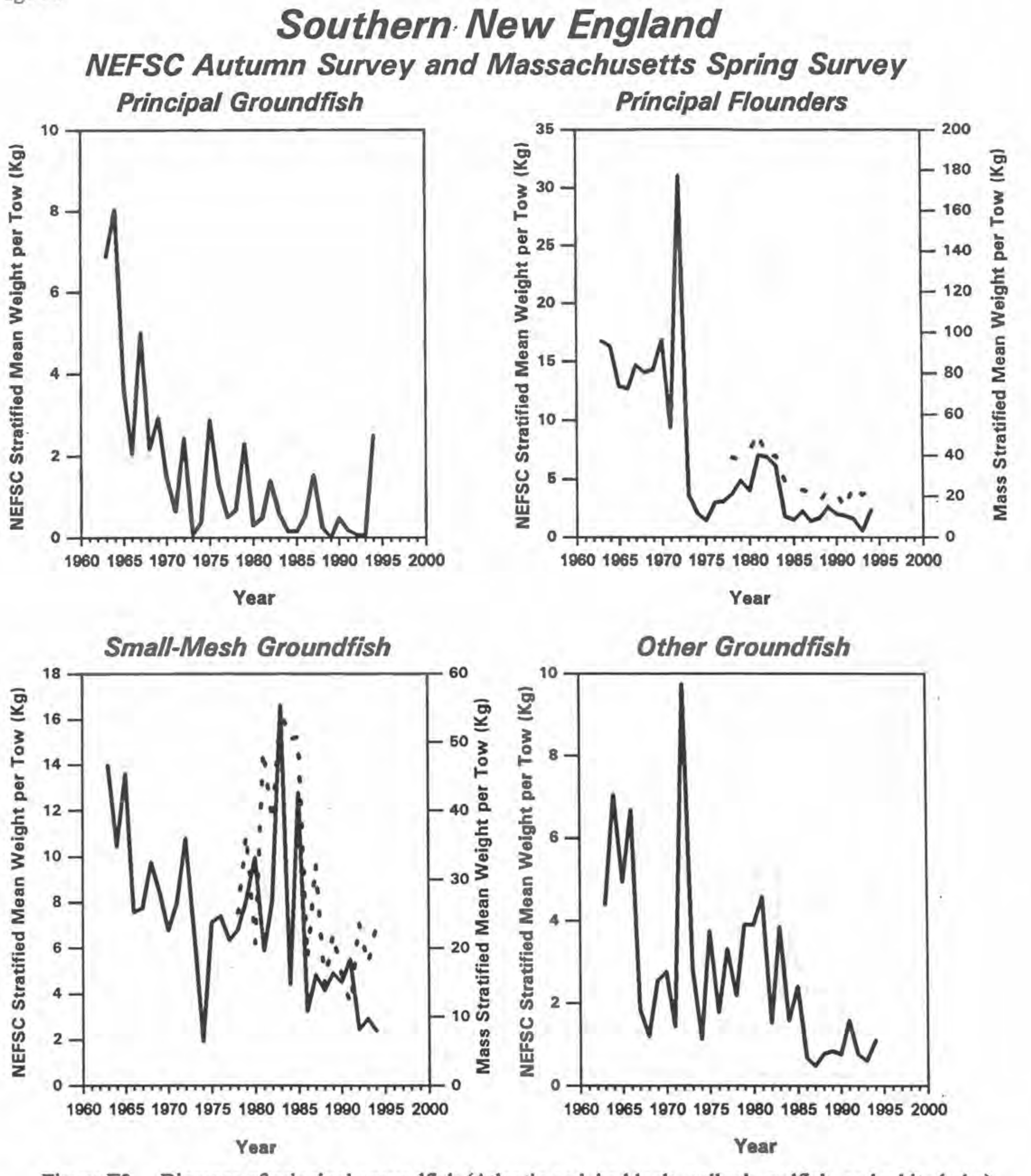


Figure E3. Biomass of principal groundfish (Atlantic cod, haddock, pollock, redfish, and white hake), principal flounders (yellowtail flounder, American plaice, witch flounder, winter flounder, and windowpane flounder), small-mesh groundfish (silver hake, red hake, and ocean pout), and other groundfish (wolffish, goosefish, and cusk) off Southern New England. Results are from NEFSC autumn offshore (solid line) and Massachusetts spring inshore (dashed line) research vessel bottom trawl surveys.

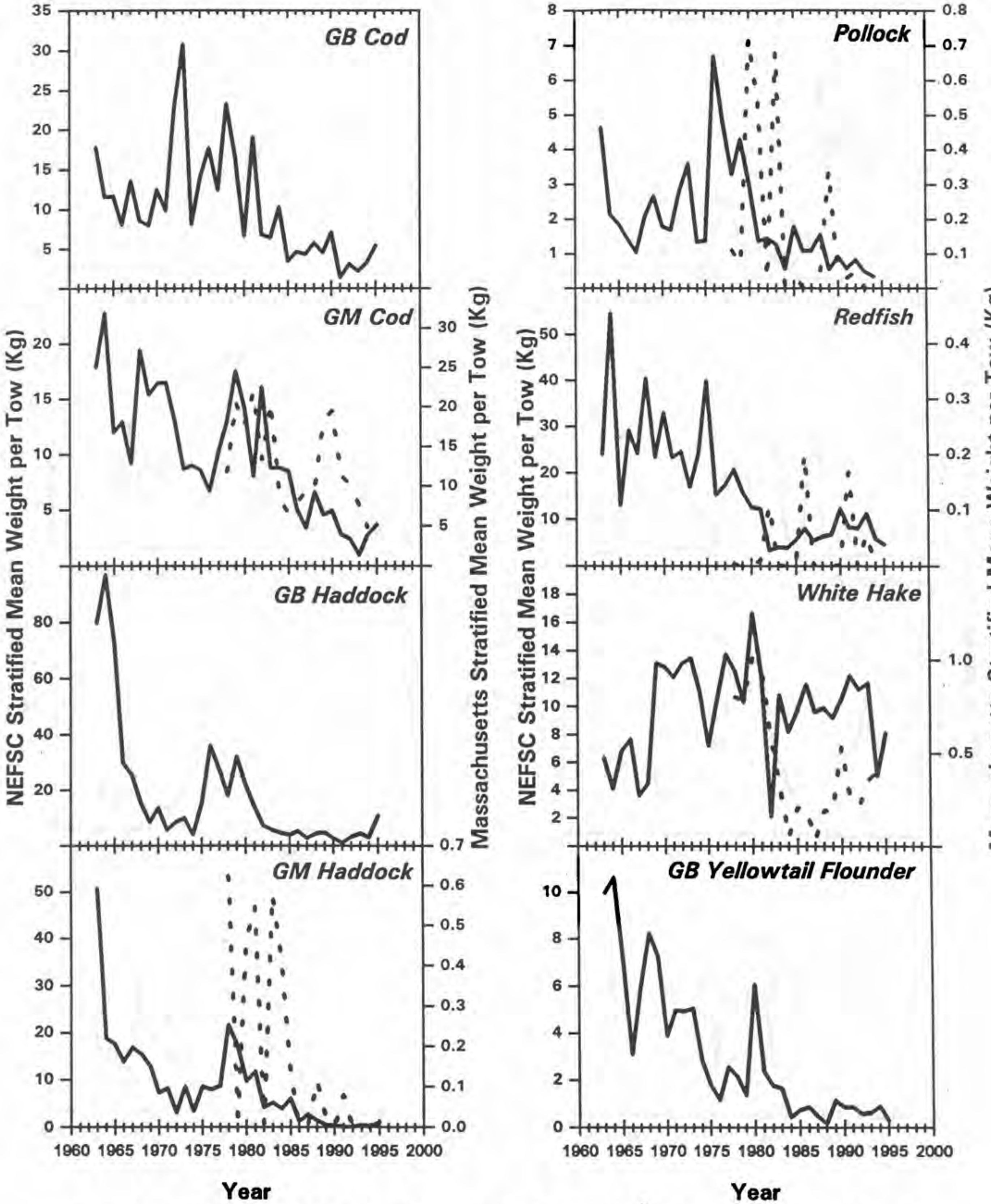


Figure E4. Biomass of 25 stocks (16 species) of groundfish and flounders comprising the Northeast Demersal Complex. Results are from NEFSC autumn offshore (solid line) and Massachusetts spring inshore (dashed line) research vessel bottom trawl surveys.

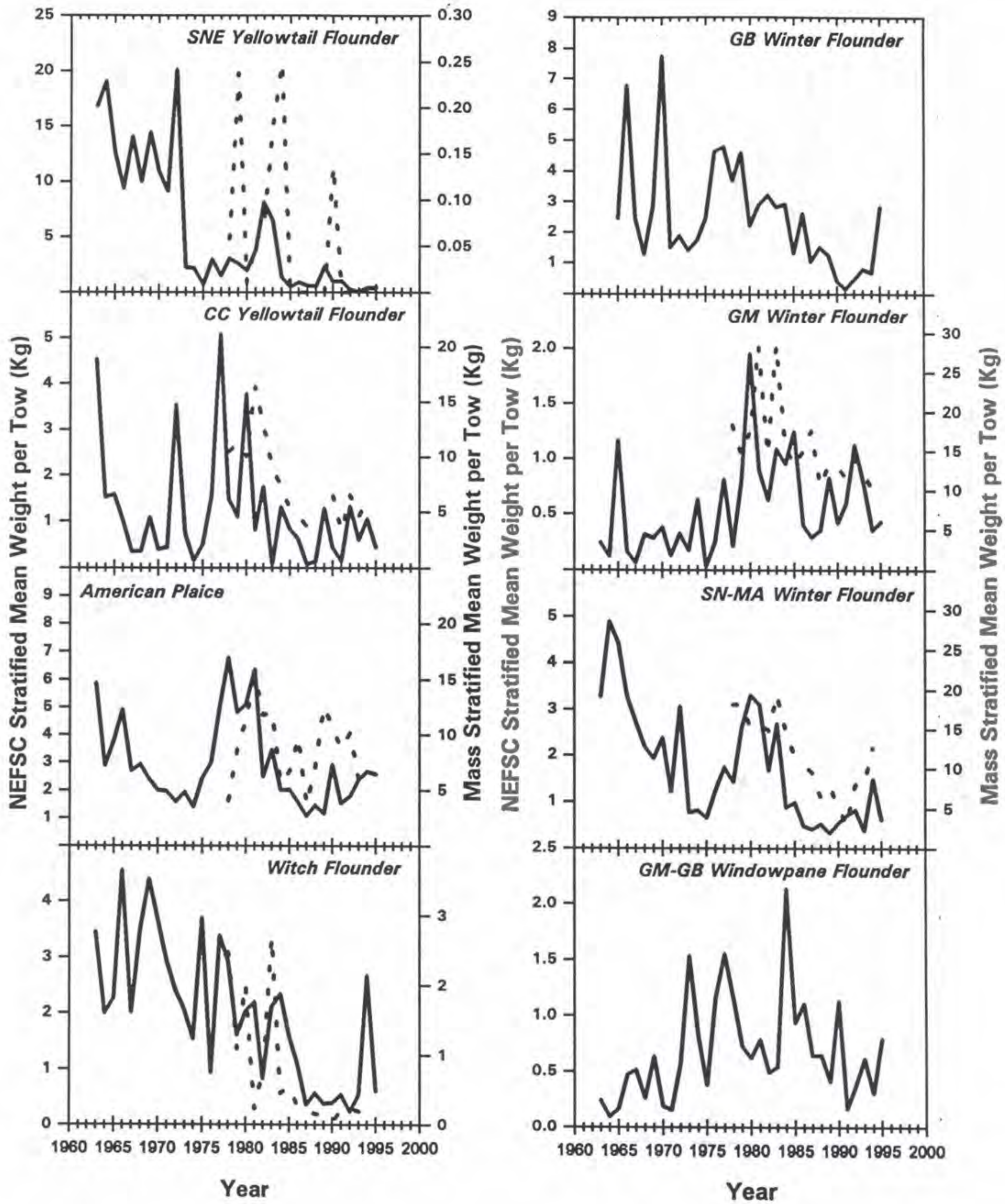


Figure E4 (Continued).

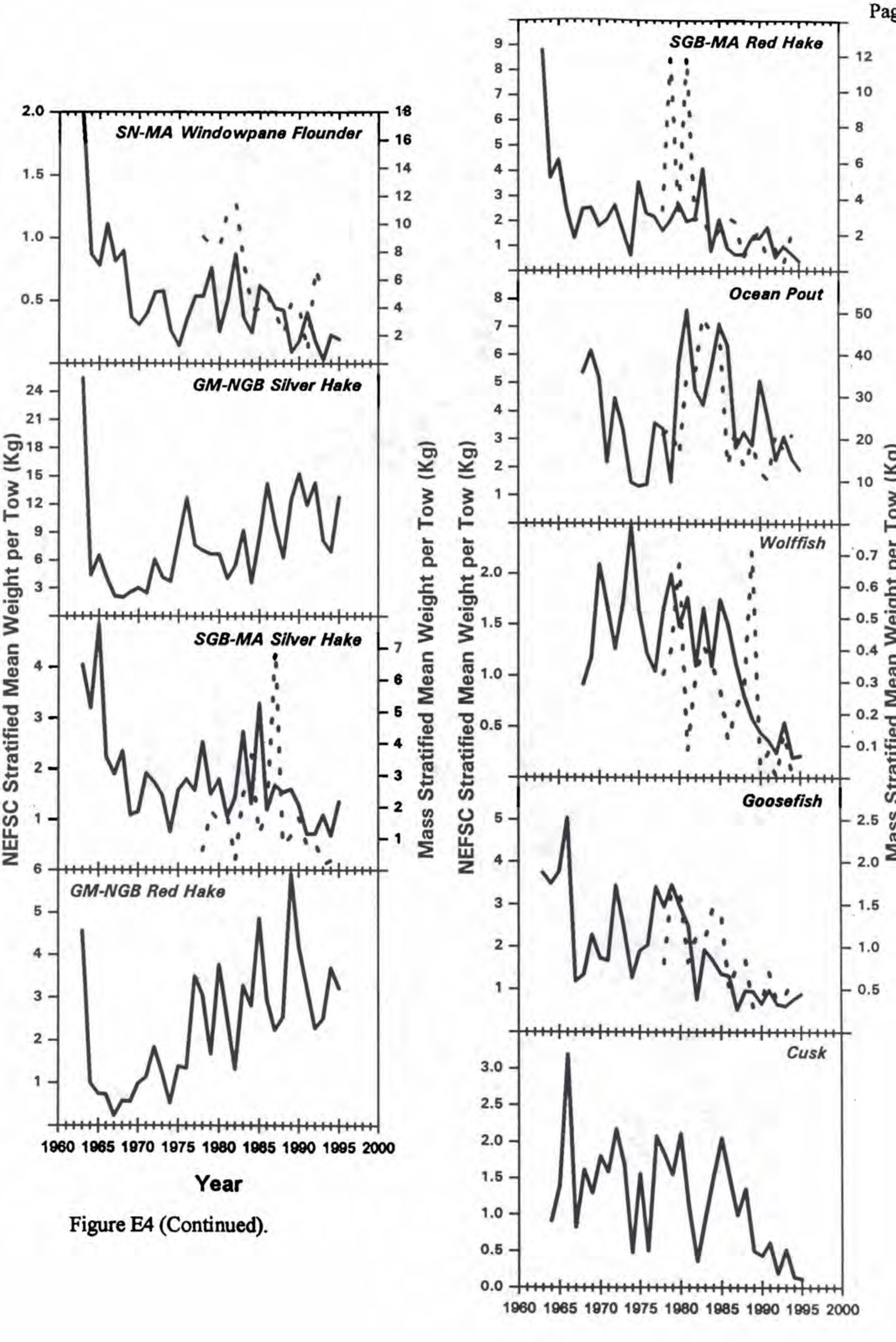


Figure E4 (Continued).

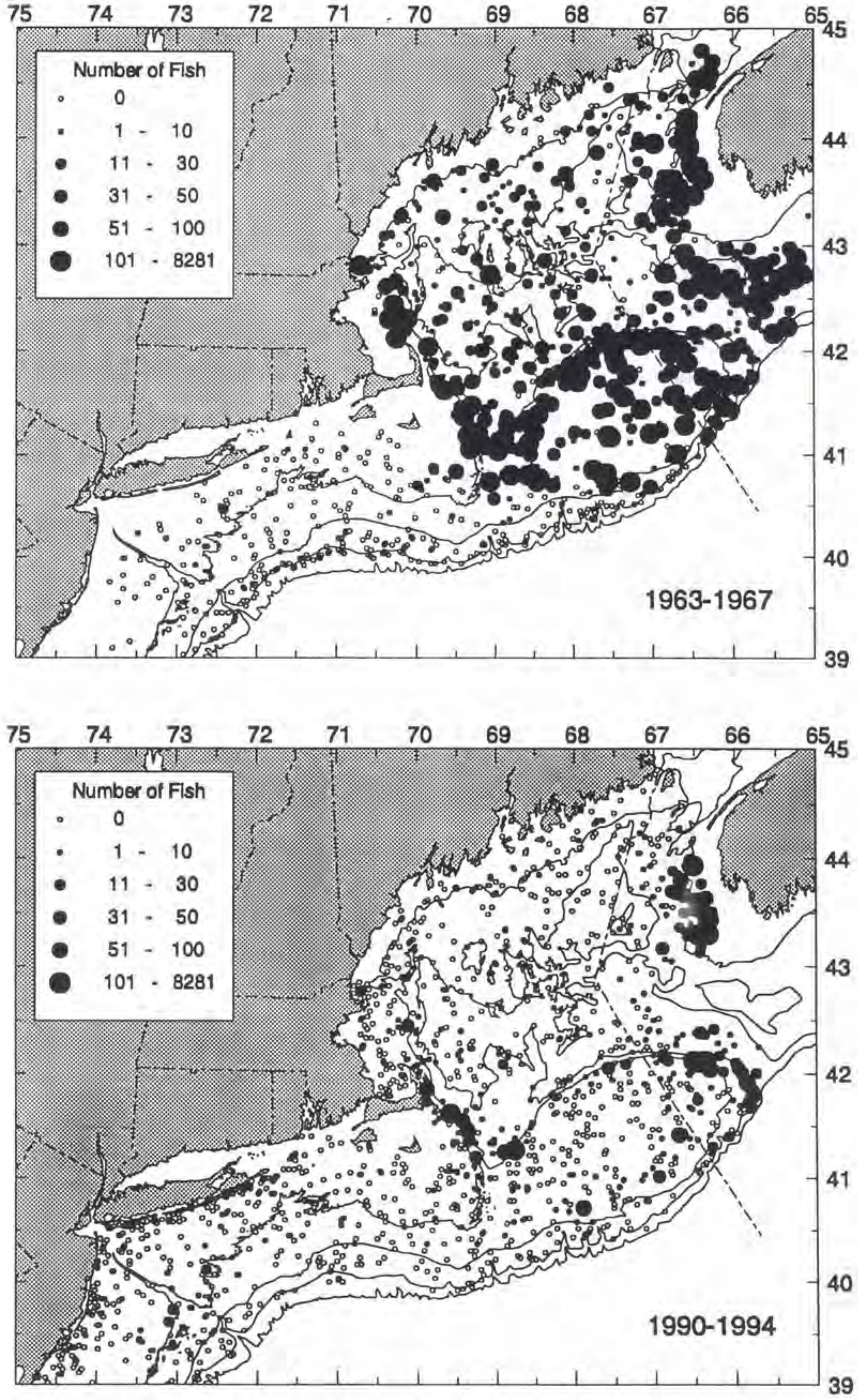


Figure E5. 5-year aggregate distribution of haddock (number caught per station) based on NEFSC autumn offshore research vessel bottom trawl surveys: 1963–1967 (top), 1990–1994 (bottom)

CONCLUSIONS OF THE SAW STEERING COMMITTEE

CONCLUSIONS OF THE SAW STEERING COMMITTEE

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

Teleconference of 19 March 1996

The SAW-21/22 Steering Committee meeting was conducted by teleconference on 19 March 1996. Meeting participants were: George Lapointe and Lisa Kline (ASMFC); Chris Moore (MAFMC); Douglas Marshall, Chris Kellogg, and Andy Applegate (NEFMC); Andrew Rosenberg and Peter Colosi (NMFS/NER); and Michael Sissenwine, Fred Serchuk, Emory Anderson, Terry Smith/SAW Chair, and Helen Mustafa/SAWs Coordinator (NMFS/NEFSC).

Dr. Terry Smith led the discussions outlined in the agenda (Table 2). Reviewed were highlights of SAW-21 meetings and documentation. Evaluation and use of logbook data in assessments was discussed at length. The Committee set the dates and the agenda for SAW-22 meetings, and discussed agendas for future SAWs.

SAW-21

SAW-21 was reported to be productive, with seven working papers recommended for publication in the NEFSC Reference Document (CRD) series (Table 3). The Committee was impressed with the CRD list and suggested that the documents be widely distributed. Several of these documents were co-authored by people outside the NEFSC. The four CRDs related to the status of the Northeast groundfish complex represent new and innovative work. Further development and broader application of this work is anticipated. In addition, some of the analytical methods will be presented at a NAFO workshop on survey data in assessments to be held in St. Petersburg, Russia in September 1996.

Most of the teleconference participants had attended at least one of the two SAW-21 Public Review Workshop sessions. Feedback from these sessions was largely related to reports on squid (MAFMC) and winter flounder (MAFMC and NEFMC). Overall, the Councils accepted the results of the SARC.

Members of the Steering Committee promised to review the research recommendations of the SARC and indicate to the Chairman what items were of particular interest to their respective organizations.

Data Issues

The need to audit and evaluate 1994 and 1995 logbook and complementary data before such data could be used in assessments was discussed. Many NEFSC staff continue to be involved in this important exercise which will limit the time available for Population Dynamics Branch staff to devote to assessments *per se*. Analysis of the fishing vessel logbook data is the most important topic on the next two SARC agendas, reducing the SARC's ability to review a 'normal' suite of stocks at SAW-22 and 23.

Most of the 1994 logbook (vessel trip report [VTR]) data have already been audited by the NEFSC. The NERO is auditing the 1995 and 1996 VTRs.

Future Stock Assessment Workshops

Data examination and evaluation will be the focus of the next two SAWs and will fully occupy much of the NEFSC Population Dynamics Branch staff within and outside the SAW process.

In deciding what stocks to review at the next two SAWs, the Committee had to consider the need for assessment review, data availability, and personnel availability. The Committee decided to review lobster, summer flounder, surfclam, and ocean quahog at the next SAW. Prepared terms of reference for these species were accepted with some modification to the terms of reference for summer flounder. The terms of reference for lobster may be modified after the Committee has had the opportunity to review the recommendations of the Lobster Review Panel.

The MAFMC and the ASMFC suggested that bluefish be on the SAW-22 agenda. It was not clear, however, whether all supporting committee work necessary to table an assessment has been completed. A suggestion to hold a bluefish workshop this summer to review assessment methodology and to provide advice on biological reference points and fishing mortality rates was discussed. The NEFSC will explore the possibility of holding such a workshop and report back to the Steering Committee. The NEFMC expressed the need to update information on goosefish (monkfish) before public hearings that will be held this summer. As there was industry interest in goosefish which should be directed into the SAW process, lead time would be required to fully involve industry representatives in the SAW process. Development of a goosefish assessment is not yet complete, however, and it will not be possible to provide a peer review of a goosefish assessment until later this year.

Past and suggested SAW assessment reviews by species are presented in Table 4.

The addition of biological sampling to the Analysis of Fishing Vessel Logbook Data item was suggested and discussed. Although this was not strictly a SARC issue, the development of biological sampling at sea was part of the terms of reference of the SAW Ad Hoc Sea Sampling Working Group, Chaired by Dr. David Pierce. The group reported at the SAW-21 and would be invited to report at the next SARC meeting as well.

SAW-22 Meetings and Agenda

Meetings:

SARC Meeting
17 - 21 June 1996
Woods Hole Laboratory

Public Review Workshop
MAFMC Meeting, 6 - 8 August 1996
NEFMC Meeting 21 - 22 August 1996

Agenda and Comments:

1. **Analysis of Fishing Vessel Logbook Data**
   The most significant topic of the agenda that will occupy the SARC for most of the week.

2. **American Lobster**
   Draft papers from the Lobster Review Panel held during the week of 25 March should be available soon after this meeting.

3. **Summer Flounder**
   The existing assessment will be updated using another year of data.

4. **Surfclam and Ocean Quahog**
   Although these stocks were reviewed at SAW-19, there is a need to review a number of ongoing assessment-related issues.

Terms of Reference (Revised following the 9 May teleconference):

ANALYSIS OF FISHING VESSEL
LOGBOOK DATA

a. Summarize spatial and temporal trends in vessel logbook entries for major offshore fisheries (e.g. New England large-mesh otter trawl, sea scallop dredge);

b. Calculate the proportion of total catch and numbers of trips that are simultaneously represented in dealer and vessel logbook databases and the fraction of permitted vessels accounted for in vessel and dealer logbooks;

c. Characterize the statistical properties of fishing effort and catch from logbooks, compared to data from the previous voluntary interview/weighout program;

d. Evaluate the utility of logbook data for allocating total landings of species to stock areas;

e. Evaluate the consistency of CPUE and effort trends using vessel logbook data;

f. Evaluate the accuracy of vessel logbook data using coincident sea sampling information;

g. Recommend changes to the logbook program to improve the usefulness of data for stock assessment.

AMERICAN LOBSTER

a. Review biological bases of stock definitions and define appropriate assessment areas;

b. Estimate abundance and mortality rates by sex and stock and quantify their precision;

c. Evaluate quantitative indicators of exploitation rates and stock status from research survey, commercial fishery and sea sampling databases, and other relevant information;

d. Address the recommendations of the Panel reviewing overfishing definitions for American lobster, and implement if possible;

e. Present the Subcommittee's general views on the Lobster Review Panel draft report, consider and incorporate to the extent possible the Panel's recommendations which pertain to the first three terms of reference particularly with respect to sensitivity analyses, and provide a prioritized research plan for addressing all of the Panel's recommendations.

SUMMER FLOUNDER

a. Update available indices of stock abundance and estimate landings and discards, as data are available;

b. Provide an updated assessment for the coastwide stock, including catch and SSB forecast options at various levels of fishing mortality and incorporating uncertainty in recruitment and stock size estimates (stochastic projections).

SURFCLAM/OCEAN QUAHOG

a. Update estimates of surfclam growth parameters;

b. Re-calculate surfclam biological reference points using revised growth and maturity data;

c. Incorporate growth of recruited surfclams into stochastic 'supply years' projection models, and revise projections made at SARC-19;

d. Incorporate growth of surfclam and ocean quahog into spreadsheet supply year models developed for the MAFMC;

e. Extend the historical time series of surfclam commercial and R/V survey data for incorporation into DeLury population models.

SAW-23 Meetings and Suggested Agenda

Meetings:

SARC Meeting
18-22 November 1996
NEFSC, Woods Hole Laboratory

Public Review Workshop
NEFMC Meeting
1st Meeting in 1997 (tentatively 22 - 23 January)
MAFMC
1st Meeting in 1997 (last week in January or first week in February)

Suggested Agenda:

1. Continue the examination of data systems and provide advice on effectiveness and recommended changes.

2. Goosefish

3. Sea Scallop

4. Georges Bank Cod

5. Georges Bank Winter Flounder

6. Shad, Weakfish, or Northern Shrimp (to be determined by ASMFC)

Other Business

Teleconference meetings of the SAW Steering Committee were judged satisfactory, although one member suggested that face-to-face meetings were preferred if budget and time permit.

A teleconference of the Steering Committee will be arranged to discuss the implications of the report of the Lobster Review Panel when the report is available.

Teleconference of 9 May 1996

Participants: J. Dunnigan, G. Lapointe, and L. Kline, ASMFC; D. Keifer and C. Moore, MAFMC; C. Kellogg and A. Applegate, NEFMC; A. Rosenberg, NMFS/NER; M. Sissenwine, E. Anderson, F. Serchuk, T. P. Smith, and H. Mustafa, NMFS/NEFSC. SAW-22 Chairman, Dr. Emory Anderson led the discussions.

The Steering Committee met again by teleconference on 9 May 1996 to 1) discuss the draft report of the Lobster Review Panel and finalize the lobster terms of reference; 2) make a final decision, based on new information, regarding bluefish on the SAW-22 agenda; and 3) consider a request to release SARC information on surfclam and ocean quahog before the SAW-22 Public Review Workshop for use at a MAFMC workshop. The Committee agreed to add an additional item (e) to the terms of reference for lobster; that bluefish would not be added to the SAW-22 SARC agenda, as a new bluefish assessment would not be completed in time for the upcoming SARC meeting; and to endorse the request by the MAFMC to use the SARC technical information on surfclam and ocean quahog before it was released at the SAW-22 Public Review Workshop.

Summary of Discussion

The Committee noted that recommendations in the draft report of the Lobster Review Panel were not prioritized, but may be prioritized in the final report. Some of these recommendations could possibly be addressed at the next SARC, but most were long-term and would have to be addressed by the SAW and other organizations. As part of its terms of reference, the Invertebrate Subcommittee was requested to give its views on the draft report, incorporate to the extent possible in the forthcoming assessment various recommendations pertaining to sensitivity analysis, and provide a research plan for addressing all of the Panel's recommendations.

The Committee concluded that the final report of the Lobster Review Panel should be issued as an independent, joint NMFS/ASMFC publication. Details regarding its publication would be handled by John Witzig for the NMFS and George Lapointe for the ASMFC. The report would be prefaced with a statement that the Panel had been organized by NMFS and ASMFC under the auspices of the NMFS Senior Scientist, at the request of the SAW Steering Committee. It was suggested that the report should be brought to the attention of the wider marine research community and possibly presented to fishermen and other interested groups by the Panel's chair.

The Committee had earlier agreed to allow a short amount of time on the SAW-22 SARC agenda for the review of any new assessment material on bluefish that might be produced in time by the ASMFC Bluefish Technical Committee. However, since the Technical Committee, at its 24-25 April meeting, was not able to provide any substantive new material, the Committee agreed to defer review of a bluefish assessment to SAW-23.

The need to use SARC information at a MAFMC Surfclam/Ocean Quahog Workshop to be held in mid-July before it would be released at the SAW-22 Public Review Workshop was discussed and endorsed. The main purpose of the Workshop would be to communicate assessment methodology to MAFMC advisors, specifically to review differences between current and past assessment techniques. Formal SAW advice would not be communicated at the time of the Workshop, as the SAW-22 process would be incomplete at that point. The Workshop would be separate from the quota setting meetings that would follow.

Before the teleconference adjourned, Dr. Anderson informed the participants that the composition of the SAW-22 SARC was complete and that Subcommittee meetings would take place over the next few weeks. In addition, under a Bilateral Agreement with Chile, Chilean biologists had expressed interest in attending the next SARC meeting as observers.

Table 2. **SAW-21/22 Steering Committee Meeting**

Teleconference
19 March 1996

(Beginning at 10:00AM)

AGENDA

1.. Report on SAW-21 SARC and SAW-21 Public Review Workshop
- a. SARC Meeting
- b. SAW Public Review Workshop
  - -South
  - -North
- c. Advisory Document

2. Data for Use in Assessments
- a. Status of logbook data
- b. Status of other data

SAW-22
- a. Meeting Dates and Places
  - - SARC Meeting, 17 - 21 June 1996, Woods Hole
  - - SAW Public Review Workshop
    - South, MAFMC Meeting, 6 - 8 August 1996
    - North, NEFMC Meeting, 14 - 15 August 1996
- b. Species
  - - proposed : summer flounder, bluefish, goosefish, sea scallop, American plaice, SNE yellowtail flounder
- c. Terms of Reference

Future SARC and Plenary Meetings
- a. SAW-23
  - - SARC Meeting, date and place
  - - SAW Public Review Workshop, MAFMC and NEFMC
  - - Suggested species: GB cod, shad, GB yellowtail flounder, weakfish, silver hake, surfclam, ocean quahog, butterfish, Northern shrimp
- b. SAW-24
  - - meeting dates, places, and species

SAW Process
- a. Meetings
- b. Documentation

Other Business

Table 3. Papers recommended for publication in the SAW-21 NEFSC Reference Document series.

Stock assessment of Short Finned Squid, *Illex illecebrosus*, in the Northwest Atlantic during 1993
by L. Hendrickson, et al.

Assessment of Winter Flounder, *Pleuronectes americanus*, in Southern New England and the Mid-Atlantic
by G. Shepherd, et al.

An Index Based Assessment of Winter Flounder, *Pleuronectes americanus*, Populations in the Gulf of Maine
by S. Cadrin, et al.

Influence of Temperature and Depth on the Distribution and Catches of Yellowtail Flounder, Cod, and Haddock in the NEFSC Trawl Survey
by T. Helser and J. Brodziak

Preliminary Results of a Spatial Analysis of Haddock Distribution Applying a Generalized Additive Model
by L. O'Brien

The Lorenz Curve Method Applied to NEFSC Bottom Trawl Survey Data
by S. Wigley

Predicting Spawning Stock Biomass for Georges Bank and Gulf of Maine Cod Stocks with Research Vessel Survey Data
by S. Cadrin and R. Mayo

Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW), Stock Assessment Review Committee (SARC) Consensus Summary of Assessments

Report of the 21st Northeast Regional Stock Assessment Workshop (21st SAW), Public Review Workshop

Table 4.

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					
BUTTERFISH	X	X		X		X		X		X		X					X						
COD, Georges Bank	X		X				X				X		X		X			X			+		X
COD, Gulf of Maine	X		X				X					X			X				X		+		
CUSK	X																				+		
FLDR, AM. PLAICE	X	X		X							X			X							+		
FLDR, SUMMER	X		X			X	+	+	X		X		X			X		X		X		X	
FLDR, WINTER, Offshore	X		X																				
FLDR, WINTER, Inshore	X		X		+	+	+						X										
FLDR, WINTER, SNE-MA																					X		
FLDR, WINTER, GOM																					X		
FLDR, WINTER, GB	X		X										X										X
FLDR, WITCH	X	X																X			+		
FLDR, Yellowtail, SNE	X	X					X					X					X				+		
FLDR, Yellowtail, GB																		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				+		
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																						
SURFCLAM	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.