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A Report of the 22nd Northeast Regional Stock Assessment Workshop

22nd Northeast Regional Stock Assessment Workshop (22nd SAW)

Public Review Workshop

U.S. DEPARTMENT OF COMMERCE
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Northeast Region
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This report is a product of the 22nd Northeast Regional Stock Assessment Workshop (22nd SAW). Proceedings and products of the 22nd SAW are scheduled to be documented and released as issues of the *Northeast Fisheries Science Center Reference Document* series. Tentative titles for the 22nd SAW are:

Estimation of catch and description of sampling programs for American lobster in the U.S. Northwest Atlantic

Length-cohort analyses of U.S. American lobster stocks

Report of the 22nd Northeast Regional Stock Assessment Workshop (22nd SAW): Public Review Workshop

Report of the 22nd Northeast Regional Stock Assessment Workshop (22nd SAW): Stock Assessment Review Committee (SARC) consensus summary of assessments

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OVERVIEW

The Public Review Workshop of the 22nd Northeast Regional Stock Assessment Workshop (SAW-22) was held in two sessions as part of the August meetings of the two regional Fishery Management Councils. The first session was held on August 7, 1996 during the Mid-Atlantic Fishery Management Council (MAFMC) meeting in Wilmington, DE and the second session was held on August 21, 1996 during the New England Fishery Management Council (NEFMC) meeting in Danvers, MA.

The purpose of the Workshop was to present to managers, industry representatives, and others the results of the peer-reviewed assessments on American lobster (Gulf of Maine, South of Cape Cod to Long Island Sound, and Georges Bank and South), summer flounder, and surfclam/ocean quahog, as well as an analysis of 1994 fishing vessel logbook data.

Presentations at both Workshop sessions were made by the SAW-22 Chairman, Dr. Emory Anderson of the NMFS, Northeast Fisheries Science Center. As an introduction, Dr. Anderson briefly reviewed the SAW process, the responsibilities of the SAW Steering Committee, participation at SAW-22 Subcommittee meetings, the composition of the SAW-22 Stock Assessment Review Committee, and the draft documentation. The presentations were based on the Advisory Report on Stock Status section contained in this report together with background information from the *22nd Northeast Regional Stock Assessment Workshop (21st SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments*. Copies of the draft 22nd SAW reports were distributed to members of each Council and made available to other meeting participants at both sessions.

Many questions were asked by participants of both sessions. Dr. Steven Murawski, Dr. Paul Rago, and Dr. Mark Terceiro assisted the SAW Chairman in answering technical questions at the MAFMC meeting and Mr. Ralph Mayo, Mr. Josef Idoine, Dr. Terceiro, and Dr. Murawski assisted at the NEFMC meeting.

This report also contains the conclusions from two SAW Steering Committee meetings held by teleconference on July 29 and August 27, 1996.

ADVISORY REPORT ON STOCK STATUS

INTRODUCTION

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

An important aspect of scientific advice on fishery resources is the determination of whether a stock is currently over-, fully-, or under-exploited. As these categories specifically refer to the act of fishing, they are best thought of in terms of exploitation rates relative to the Councils' overfishing and maximum sustainable yield (MSY) definitions. The exploitation rate is simply the proportion of the stock alive at the beginning of the year that is caught during the year. When that proportion exceeds the amount defined by the overfishing definition, it is considered to be over-exploited. 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 are classified as having high, medium, or low biomass compared to historic levels. The figure below describes this classification.

STOCK LEVEL

EXPLOITATION STATUS

	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 LEVEL	INCREASE EXPLOITATION TO REFERENCE LEVEL

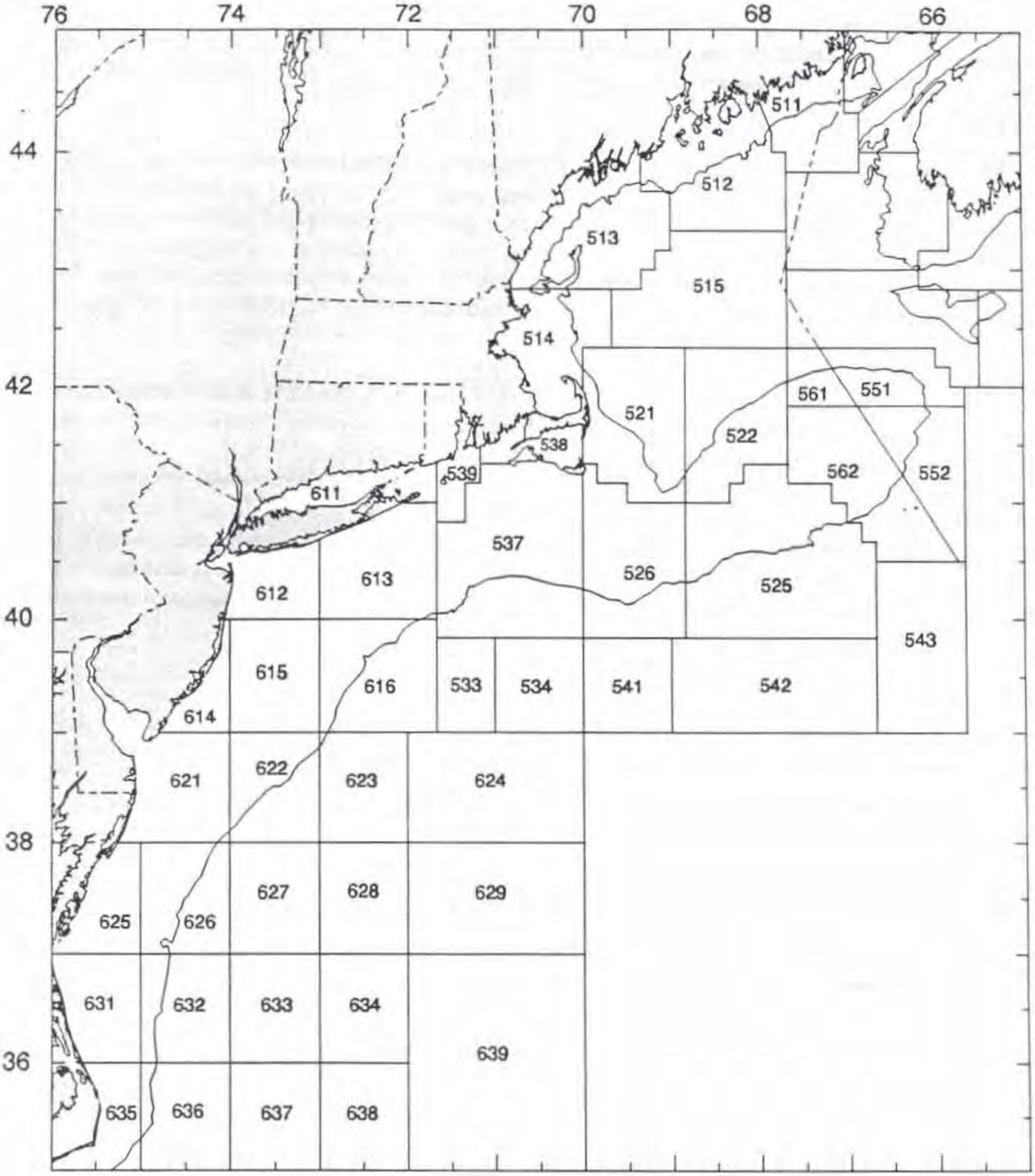


Figure 1. Statistical areas used for catch monitoring in offshore fisheries in the Northeast United States.

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 (**fishing mortality or F**) and deaths due to all other causes (**natural mortality or M**) and e is the base of the natural logarithm (2.71828). To better understand the concept of an instantaneous mortality rate, consider the following example. Suppose the instantaneous total mortality rate is 2 (i.e., Z = 2) and we want to know how many animals out of an initial population of 1 million fish will be alive at the end of one year. If the year is apportioned into 365 days (that is, the 'instant' of time is one day), then 2/365 or 0.548% of the population will die each day. On the first day of the year, 5,480 fish will die (1,000,000 x 0.00548), leaving 994,520 alive. On day 2, another 5,450 fish die (994,520 x 0.00548) leaving 989,070 alive. At the end of the year, 134,593 fish [1,000,000 x $(1 - 0.00548)^{365}$] remain alive. If, we had instead selected a smaller 'instant' of time, say an hour, 0.0228% of the population would have died by the end of the first time interval (an hour), leaving 135,304 fish alive at the end of the year [1,000,000 x $(1 - 0.00228)^{8760}$]. As the instant of time becomes shorter and shorter, the exact answer to the number of animals surviving is given by the survival curve mentioned above, or, in this example:

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

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

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

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

F_{MSY}: The fishing mortality rate which maintains a stock at the level which will produce the maximum sustainable yield.

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

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

Maximum Spawning Potential (MSP): The derived spawning stock biomass per recruit when fishing mortality is zero. The percentage value associated with MSP for a particular species or stock is derived either from a stock-recruitment relationship or, by analogy, from a closely related species for which more information is available.

Maximum Sustainable Yield (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 situation existing when the rate of fishing mortality reaches a level which causes a significant reduction in recruitment to the spawning stock. This is caused by a greatly reduced spawning stock and is characterized by a decreasing proportion of older fish in the catch and generally very low recruitment year after year.

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

Spawning stock biomass per recruit (SSB/R): The expected lifetime contribution to the spawning stock biomass for each recruit. 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 (VPA) (or cohort analysis): A retrospective analysis of the catches from a given year class which provides estimates of fishing mortality and stock size at each age over its life in the fishery. This technique is used extensively in fishery assessments.

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

Yield per recruit (Y/R or YPR): The average expected yield in weight from a single recruit. For a given exploitation pattern, rate of growth, and rate of natural mortality, an equilibrium value of Y/R is calculated for each level of fishing mortality.

Table 1. Percentage of stock (in numbers) caught annually (i.e., exploitation rate) for different natural (M) and fishing (F) mortality rates for species considered in this report.

F	M = 0.02 Ocean quahog	M = 0.05 Surfclam	M = 0.15 Lobster	M = 0.2 Summer flounder
0.1	9	9	9	9
0.2	18	18	17	16
0.3	26	25	24	24
0.4	33	32	31	30
0.5	39	38	37	36
0.6	45	44	42	41
0.7	50	49	47	46
0.8	55	54	52	51
0.9	59	58	56	55
1.0	63	62	59	58
1.1	66	65	63	62
1.2	69	68	66	65
1.3	72	71	69	67
1.4	75	74	71	70
1.5	77	76	73	72
1.6	79	78	76	74
1.7	81	80	77	76
1.8	83	82	79	78
1.9	84	84	81	79
2.0	86	85	82	81
2.1	87	86	83	82
2.2	88	87	85	83

A. ANALYSIS OF 1994 FISHING VESSEL LOGBOOK DATA ADVISORY REPORT

Commercial Fishery Data Collection Program: The vessel trip report (VTR) system became effective in April 1994 for vessels landing summer flounder, and in June 1994 for vessels landing multispecies groundfish or sea scallops. The VTR data are important to stock assessments because key information such as location, gear, and effort, previously collected by port agents, are no longer available in the dealer database.

The current data collection procedures and database structure of the recently implemented (1994) mandatory vessel and dealer reporting systems were not designed in a coordinated manner to meet multiple scientific and management needs. Most of the vessel trip report logbooks were not screened and verified to standardize the data as set out in the database design and, therefore, a substantial number of serious errors remain in the database, and the database is not likely to accurately reflect the information content of the original logs. Thus, it was not possible to provide a comprehensive evaluation as specified in the terms of reference.

Information in logbooks was compared with other sources. Specific analyses examined spatial distribution of landings and effort and correspondence between logbook information, sea sample trips, and dealer transaction reports. Data from 85% of the 1994 logbook submissions were available for analysis. Overall, comparisons between individual records in the database and their corresponding logbook pages suggest that a considerable amount of useful information is contained in the logbook entries which has not been accurately represented in the database. Despite the presence of incorrect information in many of the data fields, for those records where catch, effort, and position information is recoverable, data appear usable for undertaking priority assessment-related tasks.

Management Advice: The SARC considers the collection of commercial fishery statistics in a systematic and scientifically sound manner to be of highest priority. However, the large number of discrepancies between the information content of the submitted logbooks and the representation of these data in the database is a matter of serious concern. The SARC, therefore, recommends that immediate attention be given to both short-term problems with the 1994-1996 data and the development of long-term solutions to problems of sampling design and database management.

To address problems that exist within the current database, the SARC recommends:

1. Verification and recovery of all information contained on 1994-1996 logbooks be accomplished by screening and performing pre-audits on logbook pages as set out in the database design using software, scanned images, re-entry, or other appropriate procedures.

2. Use of existing data for provisional assessment calculations, such as allocation of catch by stock area, should be done with caution on a case-by-case basis by individuals familiar with the particular fisheries and species. Without additional auditing, all calculations based on these data must be considered preliminary. All calculations should be performed with extreme caution and full awareness of the problems in the database.

To ensure that data collected in the future are usable, the SARC recommends:

3. Analysis and design of the mandatory vessel and dealer reporting system should be completed and implemented in order to accommodate management and scientific data requirements. This analysis must reference the interrelated effect of the Regional database system (e.g., vessel and dealer permitting) on the mandatory reporting system. Such a system should have as its basis at least the following features:

   - unambiguous linking criteria that can be easily implemented for dealer, logbook, sea sampling, and effort monitoring data;

   - pre-audits of all submitted data during the data capture phase with personnel knowledgeable of the fishery, species, regulations, and the database structure and content to eliminate ambiguities in data fields and preserve the original integrity of the logbook information;

   - user-friendly data collection forms which provide clear instructions for recording data in standardized formats.

4. Until the long-term sampling design problems are resolved, immediate steps should be taken to promote cooperation between industry and managers to improve the existing data collection process by adhering to design standards, modifying collection forms and instructions, and by encouraging educational programs.

The SARC advises that experts in sampling design, database management, fishery management, and stock assessment, working in cooperation with industry representatives, be directed to implement these recommendations immediately.

Special Comments: A comprehensive evaluation of the effectiveness of the logbook program depends on the central assumption that the database contains an accurate representation of the information submitted on the logs. Without sufficient quality assurance procedures during the pre-processing, data entry, and audit stages, such accuracy cannot be assured. Such quality assurance procedures initially designed into the pre-audit phase were suspended because of management directives. Thus, many inconsistencies in the observations derived from the logbook database were often the result of erroneous or incomplete entries in the database that were not necessarily present on the original logs. Thus, it was difficult to distinguish between the inaccuracies directly attributable to the logbook information and those introduced during data entry.

Difficulties encountered in attempting to match dealer records with corresponding logbook submissions were due, in part, to the errors introduced to the database during data entry. However, matching of these two data sets is currently not possible because the design of the two data collection systems was not coordinated. An accurate alignment of the two data sets requires the presence of linking criteria on each component. This has not been achieved under the present system. Thus, trip information which, in theory, exists in the separate data sets to allow a direct match cannot be utilized unless information contained on both vessel and dealer records is linked in the database.

Source of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13.

B1. GULF OF MAINE LOBSTER ADVISORY REPORT

State of Stock: The stock is at a high level of abundance, but is overexploited. Average female F during 1991-1993 (F_{91-93} = 0.62, 43% exploitation) exceeded the overfishing definition ($F_{10\%EPR}$ = 0.32, 26% exploitation). There is a 97% probability that F_{91-93} exceeded $F_{10\%}$ (Figure B1.3). Fishing effort has reached record high levels since 1993 (Figure B1.6) suggesting that F has remained excessive in recent years even though abundance of the exploitable stock was the highest in the assessment time series in 1994 due to above-average recruitment (Figure B1.2). As the exploitation rate has increased, the fishery has become increasingly dependent on new recruits (Figure B1.5).

Management Advice: Fishing mortality should be substantially reduced to decrease the possibility of stock collapse. When stock collapse has occurred in other lobster and crustacean stocks, it has been sudden, and stock rebuilding has required decades. A decrease in F would also help restore population size structure, maximize long-term potential yield, and reduce dependence on recruitment. Additional yield and egg production would result from increasing the minimum legal size. Current measures to protect mature females would be more effective if F were reduced in the summer when females hatch their eggs.

Forecast: No forecasts were made.

Catch and Status Table (commercial landings in '000 mt, landings by sex and abundance in millions): Gulf of Maine Lobster

Year[1]	1988	1989	1990	1991	1992	1993	1994	Max	Min (1982-1993)[2]	Mean
Commercial landings	14.4	16.7	19.5	20.5	18.3	19.1	23.8	23.8	9.2	13.4
Female landings (#)[1]	13.7	14.4	17.4	15.2	14.5	16.3	-	17.4	11.7	14.0
Male landings (#)[1]	14.1	16.4	19.1	16.4	16.9	19.1	-	19.1	12.9	15.3
Female recruits[3]	23.7	19.0	24.2	22.1	19.9	23.2	-	24.2	8.9	19.7
Male recruits[3]	23.0	32.7	35.0	21.1	27.0	28.6	-	35.0	7.4	22.1
Female fully recruited[3]	9.4	14.3	13.8	14.6	14.7	16.6	20.3	20.3	3.1	13.3
Male fully recruited[3]	12.5	17.6	26.6	30.7	25.1	29.3	35.7	35.7	10.5	20.5
Female F[4]	0.69	0.73	0.81	0.76	0.59	0.52	-	0.81	0.52	0.69
Female exploitation rate	47%	49%	52%	50%	42%	38%	-	52%	38%	47%
Male F[4]	0.55	0.49	0.54	0.58	0.42	0.33	-	0.73	0.33	0.55
Male exploitation rate	40%	36%	39%	41%	32%	26%	-	49%	26%	40%

[1]Survey years: October 1 of year t to September 30 of year t+1. Applies to all estimates except commercial landings, which are in calendar years. [2]1962-1994 for commercial landings. [3]Abundance estimates from DeLury analysis of NMFS trawl survey data, 1982-1993. [4]DeLury Z - M (0.15).

Stock Identification and Distribution: American lobster are distributed from Labrador to Cape Hatteras from coastal regions to depths of 700 m. Geographic variation in genetic composition, morphometry, parasites, and life history parameters suggests that U.S. waters accommodate three distinct stocks: Gulf of Maine, Georges Bank and South, and South of Cape Cod to Long Island Sound. However, some stock mixing occurs via long distance movements of adults and larval transport. Although the Bay of Fundy and the Gulf of Maine may accommodate the same biological stock of lobsters, Canada and the U.S. manage them as separate units.

Catches: Commercial landings generally increased since the early 1970s, averaged 15,000 mt per year in the 1980s, and steadily increased to a record high of 23,800 mt in 1994 (Figure B1.1). Landings of both males and females generally increased throughout the assessment time series. Commercial landings in 1995 were unavailable.

Data and Assessment: Lobster were last assessed in 1993 (SAW-16) using DeLury, length cohort, and egg-per-recruit (EPR) analyses of females only. The current assessment includes improved estimates of catch and survey data, more intensive offshore catch sampling, analyses of males, and a more complex and realistic EPR model.

Biological Reference Points: The egg-per-recruit model indicates that the overfishing definition of $F_{10\%} = 0.32$ (26% exploitation) and female $F_{MAX} = 0.24$ (20% exploitation) (Figure B1.4). No reference points were estimated for males.

Fishing Mortality: The fishing mortality rate for females reached the lowest in the time series in 1993 and averaged 0.69 (47% exploitation) during 1982-1993 (Figure B1.1). Precision estimates indicate an 80% probability that the average female F during 1991-1993 was in the range 0.51 - 0.84 (37 - 53% exploitation). F for males was generally lower, averaging 0.55 (40% exploitation) during 1982-1993, and also declined in 1993. Fishing mortality estimates from length cohort analyses were greater than those from DeLury analyses; female F averaged 1.1 (63% exploitation) and male F averaged 1.5 (73% exploitation during 1981-1993. Ancillary information on the proportion of new recruits in the catch and the proportion of total egg production from small lobsters support high estimates of F (Figure B1.5).

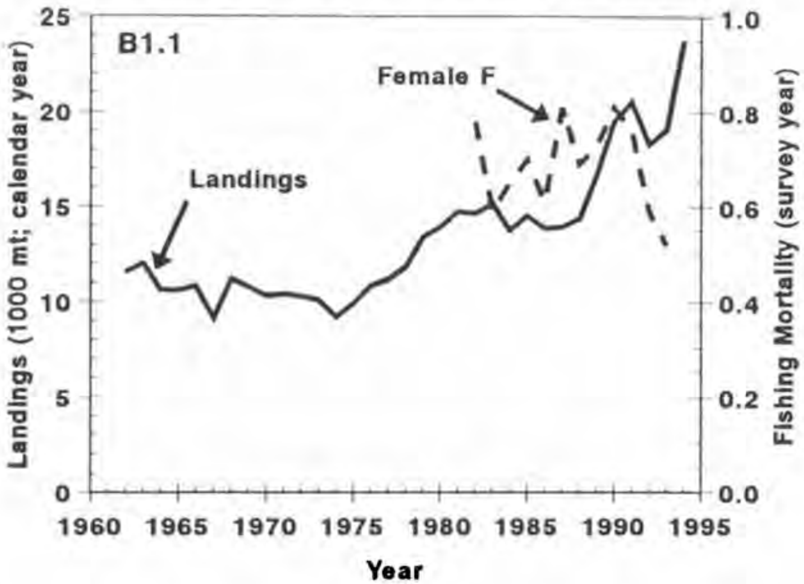
Recruitment: Female recruitment ranged from 8.9 to 24.2 million between 1982 and 1993, averaged 19.7 million, and was above the time series mean in 1990-1993 (Figure B1.2). Male recruitment was more variable, ranged between 7.4 and 35.0 million, averaged 22.1 million, and was above average during 1989-1993.

Fully-Recruited Abundance: Female abundance increased to a high of 20.3 million in 1994 (Figure B1.2). Male abundance similarly increased to a high of 35.7 million in 1994.

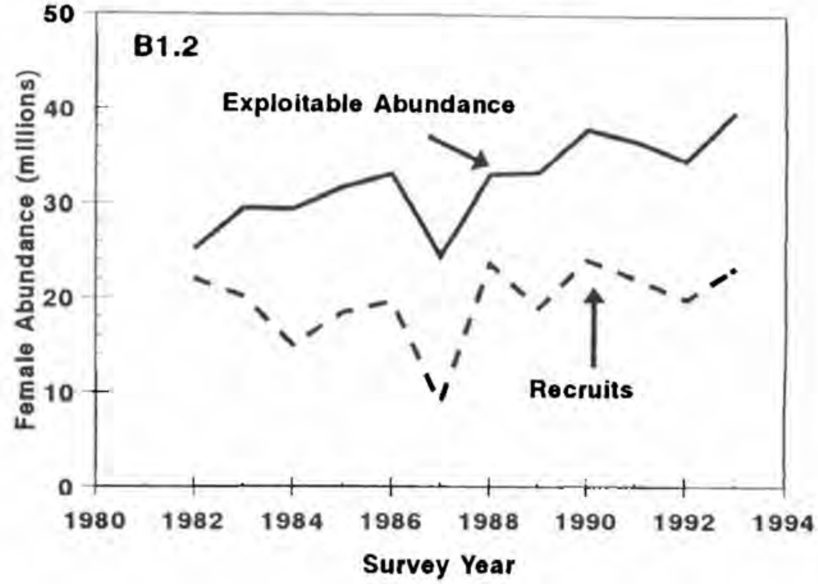
Source of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13; S. Cadrin and B. Estrella, Length-cohort analyses of U.S. American lobster stocks, NEFSC CRD 96-15; P. Rago, J. Idoine, B. Estrella, S. Cadrin, and A. Richards. Estimation of catch and description of sampling programs for American lobster in the U.S. Northwest Atlantic, NEFSC CRD 96-xx; and R.C.A. Bannister, L. Botsford, R. Mohn, V. Restrepo, and P. Sale. A review of the population dynamics of American lobster in the Northeast. NMFS and ASMFC joint publication.

Gulf of Maine Lobster

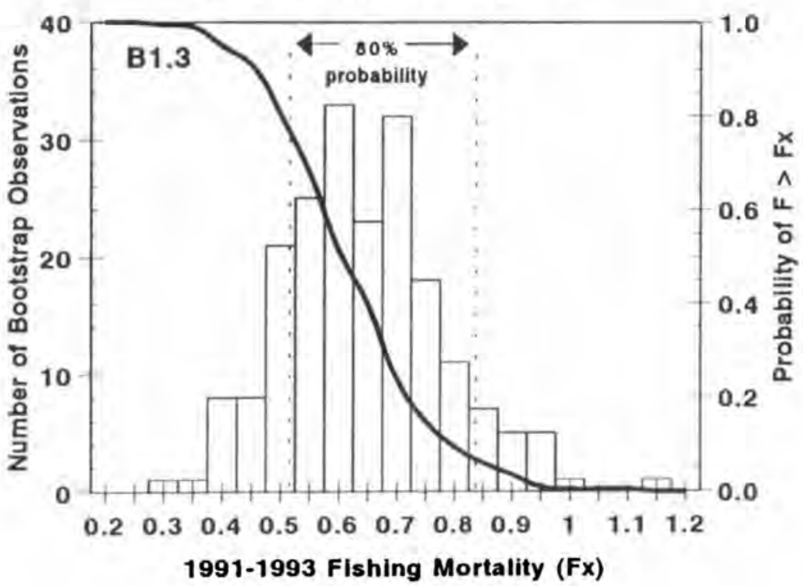
Total Landings and Fishing Mortality



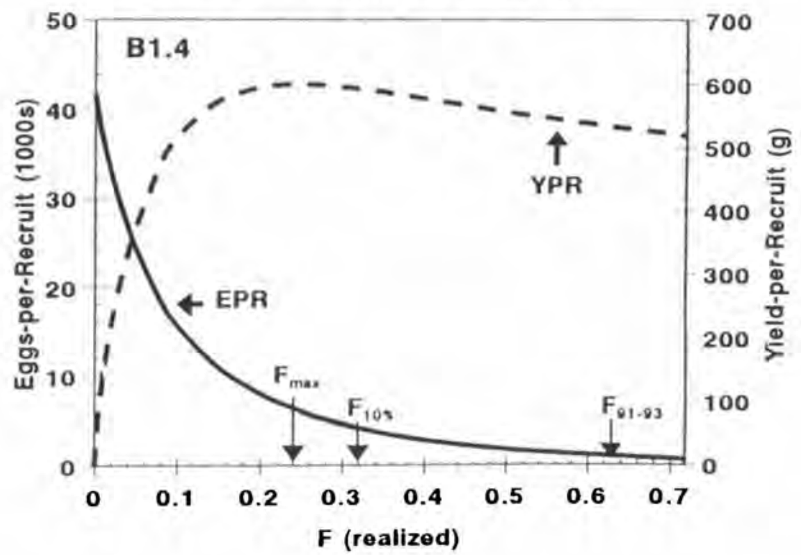
Stock Abundance and Recruitment



Precision of Female F

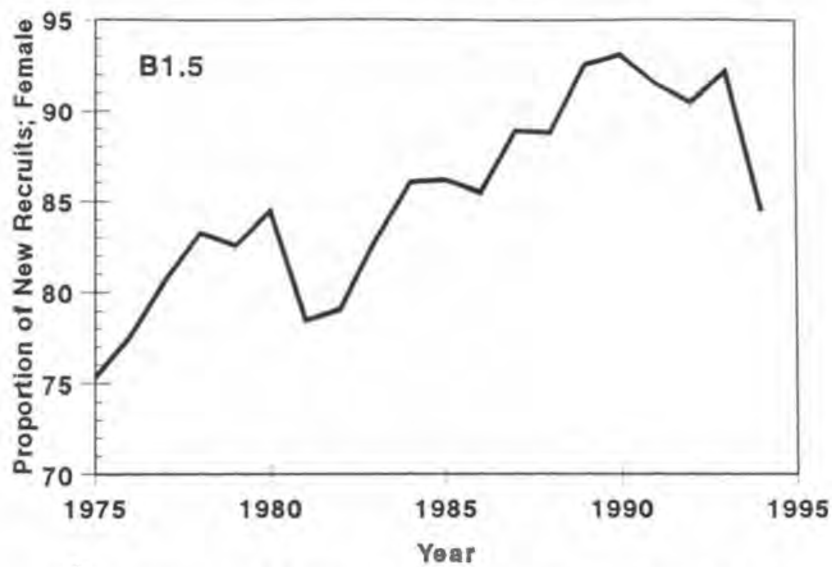


Yield and Eggs Per Recruit



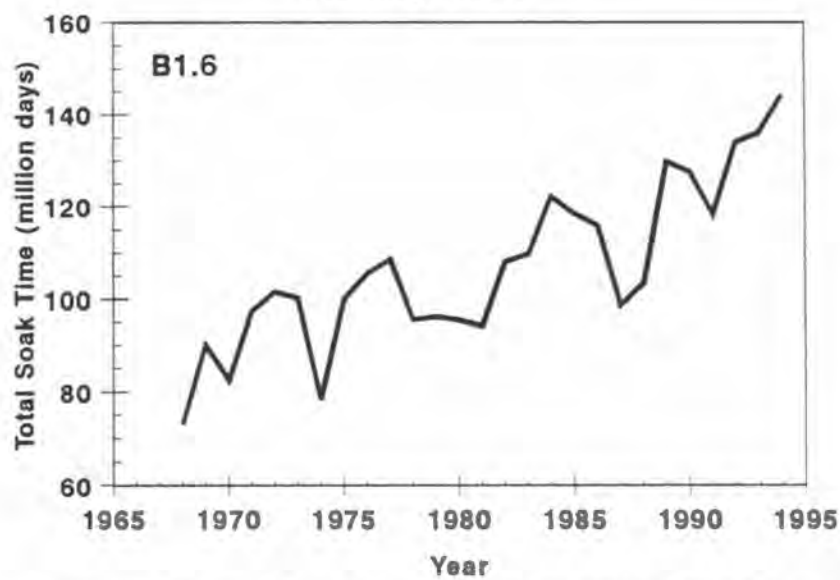
Gulf of Maine Lobster

Proportion of New Recruits* in Landings



*New recruits are within 11 mm CL of mimimum legal size

Fishing Effort



Total traps x mean soak time; from Maine DMR, areas 511-513

B2. SOUTH OF CAPE COD TO LONG ISLAND SOUND LOBSTER ADVISORY REPORT

State of Stock: The stock is at a medium level of abundance and is overexploited. Average female F during 1991-1993 ($F_{91\text{-}93}$ = 1.21, 66% exploitation) exceeded the overfishing definition ($F_{10\%EPR}$ = 0.44). There is a 100% probability that $F_{91\text{-}93}$ exceeded $F_{10\%}$ (Figure B2.3). Intense fishing has persisted after 1993 (Figure B2.6) suggesting that F has remained excessive in recent years. As the exploitation rate has increased, the fishery has become increasingly dependent on new recruits (Figure B2.5).

Management Advice: Fishing mortality should be substantially reduced to decrease the possibility of stock collapse. When stock collapse has occurred in other lobster and crustacean stocks, it has been sudden, and stock rebuilding has required decades. A decrease in F would also help restore population size structure, maximize long-term potential yield, and reduce dependence on recruitment. Additional yield and egg production would result from increasing the minimum legal size. Current measures to protect mature females would be more effective if F were reduced in the summer when females hatch their eggs.

Forecast: No forecasts were made.

Catch and Status Table (commercial landings in '000 mt, landings by sex and abundance in millions): South of Cape Cod to Long Island Sound Lobster

Year[1]	1988	1989	1990	1991	1992	1993	1994	Max	Min	Mean
								(1982-1993)[2]		
Commercial landings	4.6	3.5	4.1	4.3	4.2	4.2	5.0	5.0	0.4	2.0
Female landings (#)[1]	4.2	5.0	4.8	3.5	4.6	4.9	-	5.0	2.6	3.8
Male landings (#)[1]	2.6	3.3	3.9	3.3	4.0	3.8	-	4.0	1.7	2.8
Female recruits[3]	4.2	8.0	6.6	4.2	6.7	2.3	-	8.0	0.8	4.5
Male recruits[3]	2.5	3.7	5.7	2.3	4.9	3.3	-	6.5	0.1	3.0
Female fully recruited[3]	1.5	0.8	2.7	3.3	3.1	3.9	0.6	4.5	0.6	2.2
Male fully recruited[3]	1.4	1.0	0.9	2.2	0.9	1.3	0.4	3.9	0.0	1.3
Female F[4]	1.81	1.05	0.87	0.72	0.78	2.12	-	2.12	0.44	1.13
Female exploitation rate	79%	61%	55%	48%	51%	84%	-	84%	33%	64%
Male F[4]	1.24	1.49	0.95	1.45	1.35	2.24	-	3.79	0.38	1.42
Male exploitation rate	67%	73%	58%	72%	70%	85%	-	94%	29%	72%

[1]Survey years: October 1 of year t to September 30 of year t+1. Applies to all estimates except commercial landings, which are in calendar years. [2]1962-1994 for commercial landings. [3]Abundance estimates from DeLury analysis of NMFS trawl survey data, 1982-1993. [4]DeLury Z - M (0.15).

Stock Identification and Distribution: American lobster are distributed from Labrador to Cape Hatteras from coastal regions to depths of 700 m. Geographic variation in genetic composition, morphometry, parasites, and life history parameters suggests that U.S. waters accommodate three distinct stocks: Gulf of Maine, Georges Bank and South, and South of Cape Cod to Long Island Sound. However, some stock mixing occurs via long distance movements of adults and larval transport. Evidence for a separate Central and Western Long Island Sound stock is inconclusive.

Catches: Commercial landings generally increased from about 1,000 mt in 1962-1981 to approximately 4,000 mt during 1984-1993 and to a record high 5,000 mt in 1994 (Figure B2.1). Landings of females (in numbers) averaged 3.8 million during 1982-1993, somewhat higher than male landings which averaged 2.8 million. Commercial landings in 1995 were unavailable.

Data and Assessment: Lobster were last assessed in 1993 (SAW-16) using DeLury and egg-per-recruit (EPR) analyses of females only. The current assessment includes improved estimates of catch and survey data, male analyses, length cohort analyses, and a more complex and realistic EPR model.

Biological Reference Points: The egg-per-recruit model indicates that the overfishing definition of $F_{10\%}$ = 0.44 (33% exploitation) and female F_{MAX} = 0.33 (26% exploitation) (Figure B2.4). There are some uncertainties in the estimates of the biological parameters used in the EPR models. No biological reference points were estimated for males.

Fishing Mortality: During 1982-1993, the fishing mortality rate for females averaged 1.13 (64% exploitation) and reached its highest level (F = 2.12, 84% exploitation) in 1993 (Figure B2.1). Precision estimates indicate an 80% probability that the 1991-1993 average F was between 1.09 and 1.51 (62 - 74% exploitation). Male F was generally higher ranging between 0.38 (29% exploitation) and 3.79 (94% exploitation) and averaging 1.42 (72% exploitation). F estimates from preliminary DeLury analysis of the RI trawl survey data were similar; mean female F was 1.53 (74% exploitation), and mean male F was 1.92 (81% exploitation) during 1982-1993. F estimates from length cohort analyses were also similar, with female F averaging 1.0 (59% exploitation) and male F averaging 1.8 (79% exploitation) between 1982 and 1993. Ancillary information on the proportion of new recruits in the catch and the proportion of total egg production from small lobsters support high estimates of F (Figure B2.5).

Recruitment: Female recruitment ranged from 0.8 to 8.0 million and averaged 4.5 million from 1982 to 1993 (Figure B2.2). Male recruitment ranged from 0.1 to 6.5 million and averaged 3.0 million.

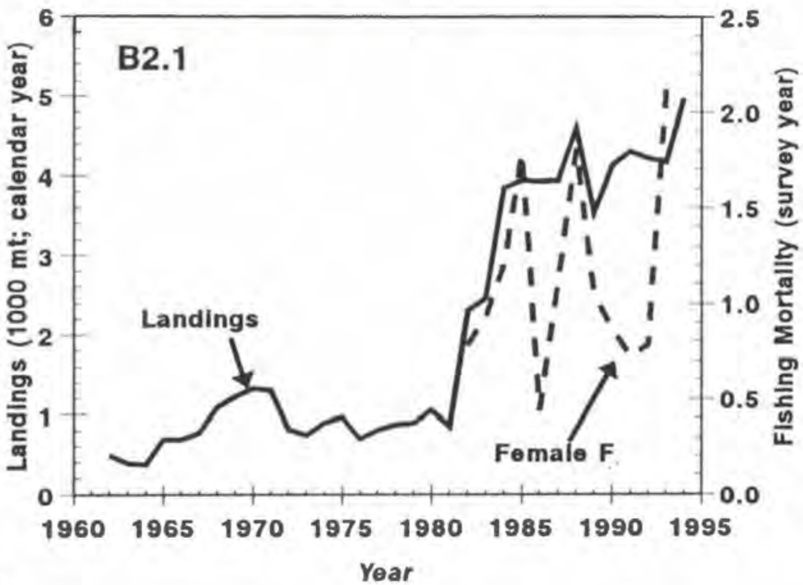
Fully-Recruited Abundance: Female abundance ranged between 0.6 and 4.5 million during 1982-1994 and was at its lowest level (0.6 million) in 1994 (Figure B2.2). Male abundance ranged from 0.04 to 3.9 million and was also lowest in 1994.

Assessment of a Sub-Area: DeLury, length cohort and egg-per-recruit analyses were performed for Central and Western Long Island Sound, which is currently considered to be a component of the South of Cape to Long Island Sound stock. Preliminary results indicate that the status of the resource in the sub-area is similar to that of the entire stock. Landings increased throughout the 1984-1993 assessment time series and female F averaged 1.7 (77% exploitation), greatly in excess of the provisional overfishing reference point ($F_{10\%}$ = 0.52, 38% exploitation).

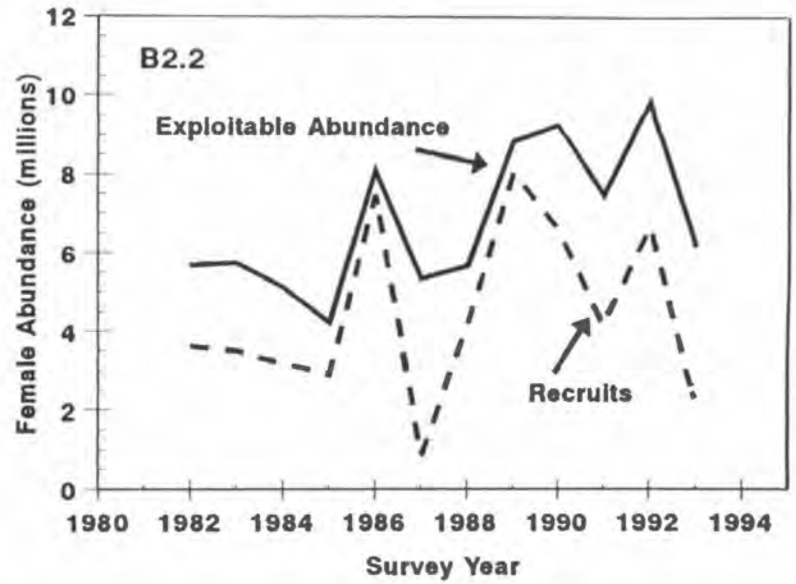
Source of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13; S. Cadrin and B. Estrella, Length-cohort analyses of U.S. American lobster stocks, NEFSC CRD 96-15; P. Rago, J. Idoine, B. Estrella, S. Cadrin, and A. Richards. Estimation of catch and description of sampling programs for American lobster in the U.S. Northwest Atlantic, NEFSC CRD 96-xx; and R.C.A. Bannister, L. Botsford, R. Mohn, V. Restrepo, and P. Sale. A review of the population dynamics of American lobster in the Northeast. NMFS and ASMFC joint publication.

South of Cape Cod to Long Island Sound Lobster

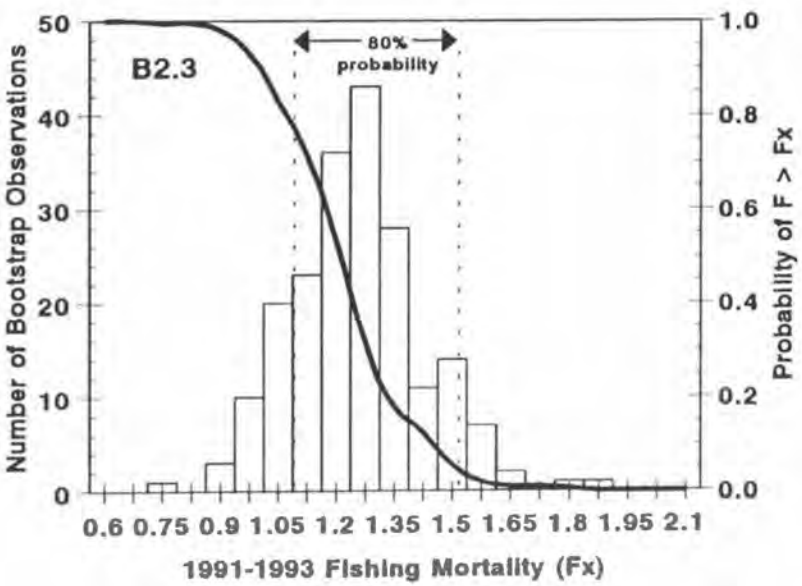
Total Landings and Fishing Mortality



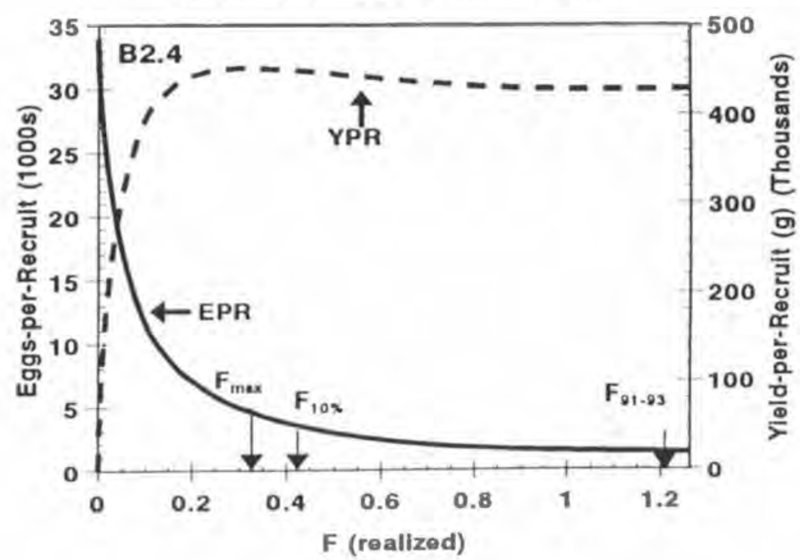
Stock Abundance and Recruitment



Precision of Female F

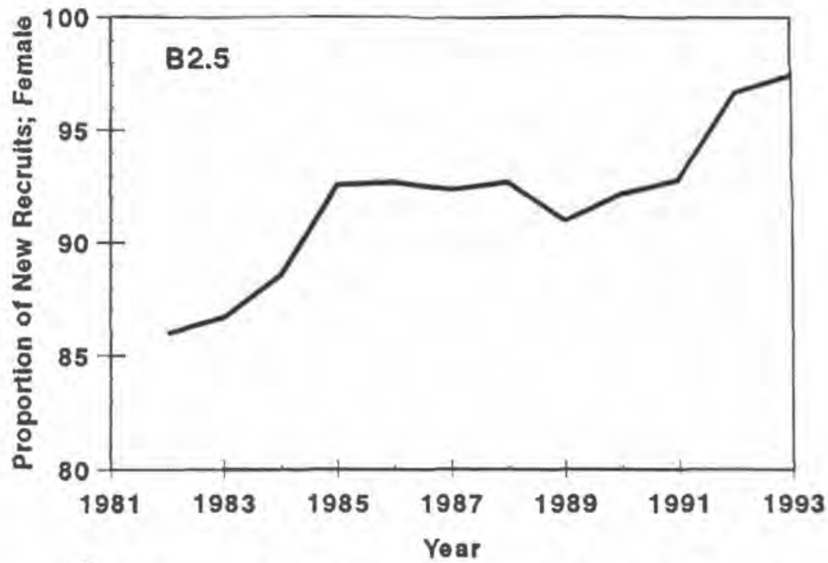


Yield and Eggs Per Recruit



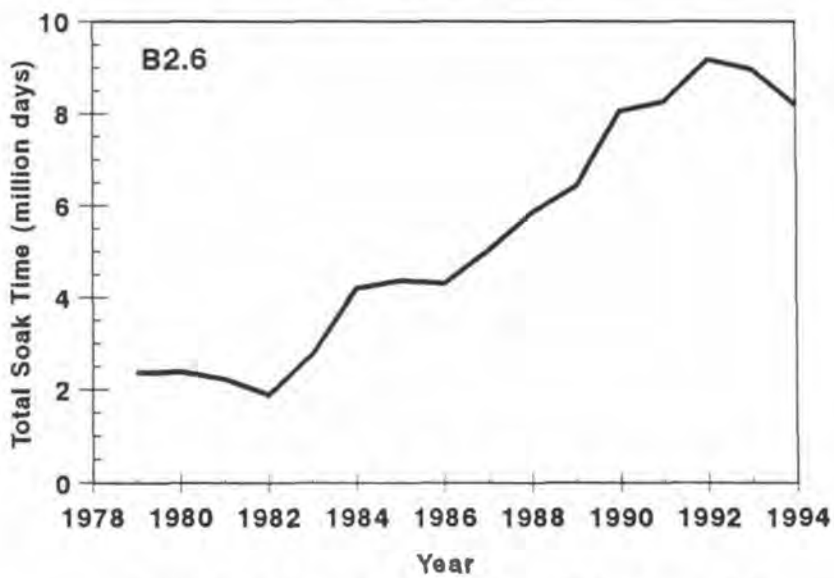
South of Cape Cod to Long Island Sound Lobster

Proportion of New Recruits in Landings*



*New recruits are within 10 mm CL of minimum legal size

FISHING EFFORT



Total traps x mean soak time; CT DEP area 611

B3. GEORGES BANK AND SOUTH LOBSTER ADVISORY REPORT

State of Stock: The stock is at a medium level of abundance and is overexploited. Average female F during 1991-1993 ($F_{91\text{-}93}$ = 0.50, 37% exploitation) exceeded the overfishing definition ($F_{10\%EPR}$ = 0.36, 28% exploitation). There is a 100% probability that $F_{91\text{-}93}$ exceeded $F_{10\%}$ (Figure B3.3) and there is no evidence that F has decreased since 1993. As the exploitation rate has increased, the fishery has become increasingly dependent on new recruits (Figure B3.5).

Management Advice: Fishing mortality should be reduced to decrease the possibility of stock collapse. This advice is qualitatively different than that given in SAW-16. More accurate estimates of catch and other components in this assessment show that F is excessive and the fishery is increasingly dependent on recruitment. A reduction in F would help restore population size structure, maximize long-term potential yield, and reduce dependence on recruitment. Additional yield and egg production would result from increasing the minimum legal size. The Georges Bank and South stock may now be an important source of larval supply for inshore areas. Simulation modeling suggests that high exploitation of the offshore stock and loss of larval subsidy may increase the risk of recruitment failure for the entire U.S. lobster resource.

Forecast: No forecasts were made.

Catch and Status Table (commercial landings in '000 mt, landings by sex and abundance in millions): Georges Bank and South Lobster

Year[1]	1988	1989	1990	1991	1992	1993	1994	Max (1982-1993)[2]	Min (1982-1993)[2]	Mean (1982-1993)[2]
Commercial landings	3.0	3.3	4.2	4.0	3.8	3.5	2.9	4.2	1.3	2.8
Female landings (#)[1]	2.2	2.5	4.6	3.1	2.8	1.4	-	4.6	1.4	2.3
Male landings (#)[1]	3.0	3.3	3.0	3.3	3.4	2.0	-	3.4	1.9	2.7
Female recruits[3]	2.6	4.3	6.0	2.6	4.4	2.4	-	6.0	2.4	3.3
Male recruits[3]	2.6	3.7	3.1	3.5	3.3	2.3	-	4.5	2.0	3.2
Female fully recruited[3]	3.7	3.4	4.4	4.7	3.3	3.8	3.8	4.7	3.2	3.8
Male fully recruited[3]	3.5	2.7	2.6	2.3	2.0	1.5	1.4	3.5	1.4	2.3
Female F[4]	0.46	0.43	0.64	0.63	0.55	0.33	-	0.64	0.33	0.47
Female exploitation rate	35%	33%	45%	45%	40%	27%	-	44%	26%	35%
Male F[4]	0.66	0.76	0.76	0.89	1.13	0.82	-	1.13	0.50	0.74
Male exploitation rate	45%	50%	50%	55%	64%	52%	-	64%	37%	49%

[1]Survey years: October 1 of year t to September 30 of year t+1. Applies to all estimates except commercial landings, which are in calendar years. [2]1962-1994 for commercial landings. [3]Abundance estimates from DeLury analysis of NMFS trawl survey data, 1982-1993. [4]DeLury Z - M (0.15).

Stock Identification and Distribution: American lobster are distributed from Labrador to Cape Hatteras from coastal regions to depths of 700 m. Geographic variation in genetic composition, morphometry, parasites, and life history parameters suggests that U.S. waters accommodate three distinct stocks: Gulf of Maine, Georges Bank and South, and South of Cape Cod to Long Island Sound. However, some stock mixing occurs via long distance movements of adults and larval transport.

Catches: Commercial landings generally increased in the 1960s, decreased in the 1970s, increased in the 1980s to a peak of 4,200 mt in 1990, and declined to 2,900 mt in 1994 (Figure B3.1). Landings of females and males were similar during 1982-1993, averaging 2.3 million and 2.7 million in numbers, respectively. Commercial landings in 1995 were unavailable.

Data and Assessment: Lobster were last assessed in 1993 (SAW-16) using DeLury and egg-per-recruit (EPR) analyses of females only. The current assessment involved a complete re-estimation of offshore lobster landings by more thorough analysis of canvas, weighout, and state logbook data. Biological samples were improved through more intensive NEFSC sea sampling, state sea sampling data, Canadian DFO sea sampling data, and re-examination of port samples. The current analyses include length cohort analyses, male analyses, and a more complex and realistic EPR model.

Biological Reference Points: The egg-per-recruit model indicates that the overfishing definition of $F_{10\%}$ = 0.36 (28% exploitation) and female F_{MAX} = 0.15 (13% exploitation) (Figure B3.4). No reference points were estimated for males.

Fishing Mortality: During 1981-1993, the fishing mortality rate of females averaged 0.47 (35% exploitation) and was lowest in 1993 (Figure B3.1). Precision estimates indicate an 80% probability that the 1991-1993 mean F was between 0.45 (34% exploitation) and 0.58 (41% exploitation). Male F was greater, ranging from 0.50 (37% exploitation) to 1.13 (64% exploitation) and averaging 0.74 (49% exploitation). F estimates from length cohort analyses were greater; female F averaged 1.0 (59% exploitation) and male F averaged 1.4 (71% exploitation). Ancillary information on the proportion of new recruits in the catch and the proportion of total egg production from small lobsters support high estimates of F and increasing dependence on recruitment (Figure B3.5).

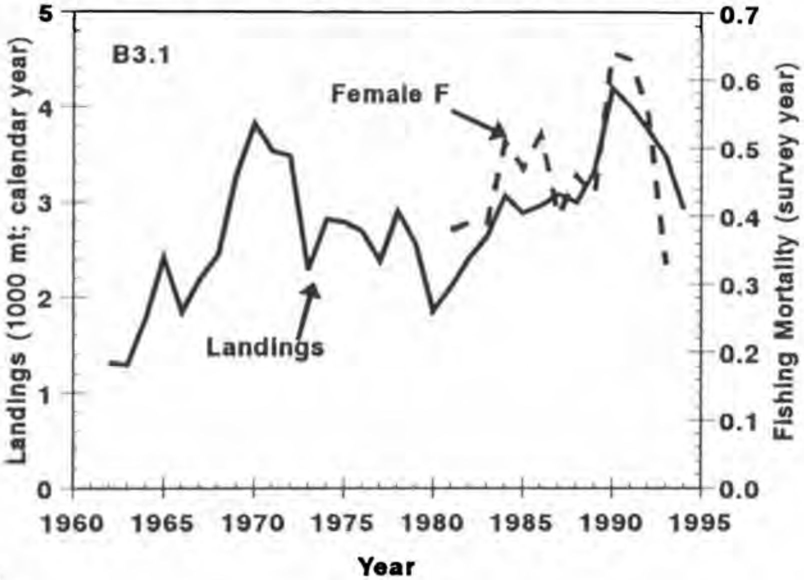
Recruitment: Female recruitment ranged from 2.4 to 6.0 million and averaged 3.3 million during 1982-1993 (Figure B3.2). Male recruitment was less variable and averaged 3.2 million.

Fully-Recruited Abundance: Female abundance varied from 3.2 million to 4.7 million and averaged 3.8 million from 1981 to 1994 (Figure B3.2), while abundance of males was generally lower, ranging from 1.4 to 3.5 million and averaging 2.3 million.

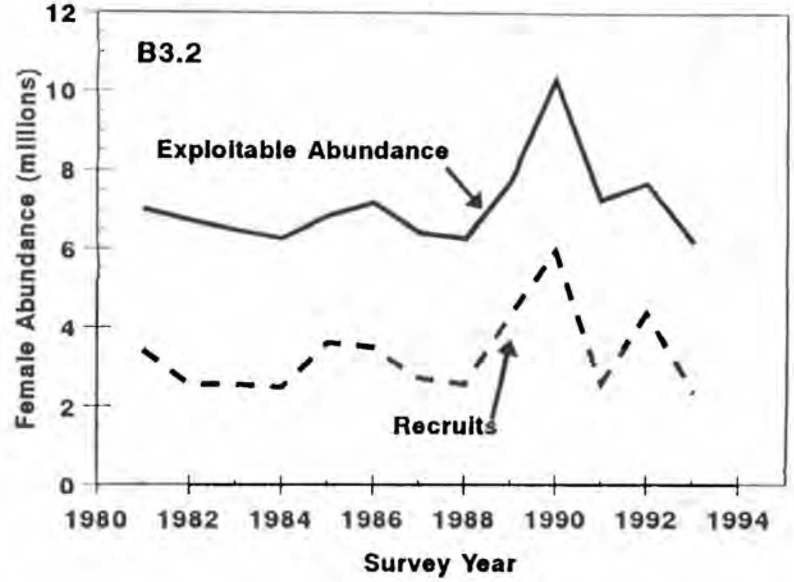
Source of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13; S. Cadrin and B. Estrella, Length-cohort analyses of U.S. American lobster stocks, NEFSC CRD 96-15; P. Rago, J. Idoine, B. Estrella, S. Cadrin, and A. Richards. Estimation of catch and description of sampling programs for American lobster in the U.S. Northwest Atlantic, NEFSC CRD 96-xx; and R.C.A. Bannister, L. Botsford, R. Mohn, V. Restrepo, and P. Sale. A review of the population dynamics of American lobster in the Northeast. NMFS and ASMFC joint publication.

Georges Bank and South Lobster

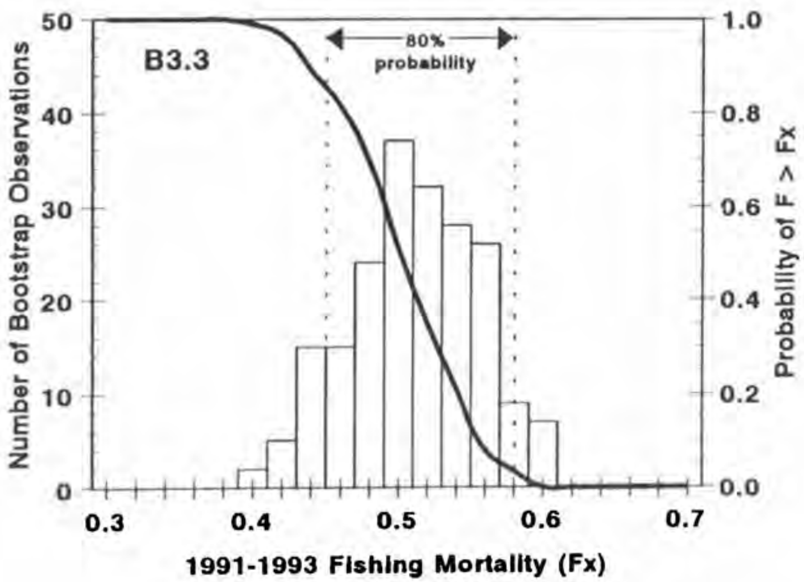
Total Landings and Fishing Mortality



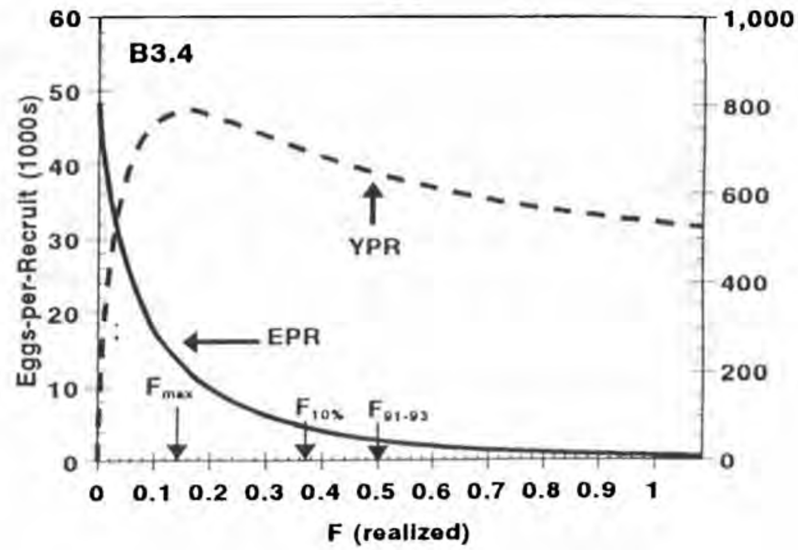
Stock Abundance and Recruitment



Precision of Female F

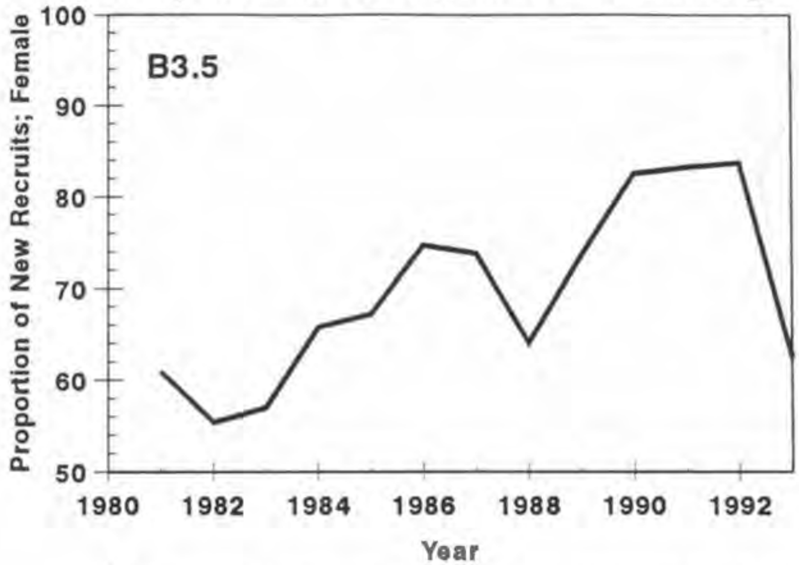


Yield and Eggs Per Recruit



Georges Bank and South Lobster

Proportion of New Recruits in Landings*



* New recruits are within 1 molt of minimum legal size

C. SUMMER FLOUNDER ADVISORY REPORT

State of Stock: The stock is at a medium level of historical abundance and is overexploited. The fishing mortality rate on summer flounder is high, peaking at 2.1 (82% exploitation) in 1992, and was estimated to be 1.5 (72% exploitation) in 1995 (Figure C1). The current estimate of fishing mortality is above the management targets [F_{TGT} = 0.53 (38% exploitation) in 1995, F_{MAX} = 0.23 (19% exploitation)]. There is an 80% chance that the 1995 F was between 1.3 (67% exploitation) and 1.8 (78% exploitation) (Figure C6). Spawning stock biomass (age 0 and older) has increased since 1989 (5,247 mt) to 15,235 mt in 1995, about 80% of the level estimated for 1983. There is an 80% chance that the 1995 spawning stock biomass was between 12,500 mt and 20,000 mt (Figure C5). The age structure of the spawning stock in 1995 remains truncated, with only 12% of the biomass at ages 2 and older. Under equilibrium conditions at F_{MAX}, at least 88% of the spawning stock biomass would be expected to be age 2 and older. Recruitment has improved in recent years, and the 1995 year class may be the best since 1983, but spawning stock rebuilding at ages 2 and older is not occurring as projected in previous assessments (Figure C2). Previous assessments have consistently underestimated fishing mortality, with unaccounted catch being a plausible cause.

Management Advice: Despite the management measures already implemented, further reductions in exploitation are needed to meet fishing mortality rate targets. These reductions are necessary because historical experience and new analyses indicate that assessments and projections have underestimated fishing mortality and overestimated stock size each year since 1991. The degree of underestimation of fishing mortality in 1996 is uncertain, but will affect all of the projections. For this reason, projection options that account for the underestimation of fishing mortality are more likely to achieve target fishing mortality rates. The presence of relatively strong incoming recruitment, which is supporting the fishery in 1996, affords an opportunity to rebuild the spawning stock biomass while allowing modest catches.

Forecast for 1996-1998: Stochastic projections incorporate uncertainty in 1996 stock sizes due to survey variability and assume the 1996 quota will be landed and no dramatic increase in discarding will occur. Under Option 1 (target F = 0.30 in 1997, 24% exploitation), landings of 8,400 mt and discards of 1,900 mt in 1996 provide a median (50% probability) F = 0.52 (37% exploitation), and landings of 9,250 mt and discards of 800 mt in 1997 provide a median F = 0.30 (24% exploitation), achieving the management target, with a median spawning stock biomass level of 33,200 mt (Figure C4). Under Option 2 (quota capped at 8,400 mt in 1997), landings of 8,400 mt and discards of 1,900 mt in 1996 provide a median F = 0.52 (37% exploitation), and landings of 8,400 mt and discards of 700 mt in 1997 provide a median F = 0.27 (22% exploitation), with a median spawning stock biomass level of 33,900 mt. The fishing mortality rates associated with Options 1 and 2 will likely be greater than projected in 1996 and 1997 because of the pattern of underestimation of fishing mortality in the assessment. Under Options 3 and 4, stock sizes in 1996 are reduced to account for this pattern. Under Option 3 (F_{TGT} = 0.30 in 1997, 24% exploitation), landings of 8,400 mt in 1996 provide a median F = 0.68 (45% exploitation), and a reduction in landings in 1997 to 6,350 mt is necessary to achieve a median F = 0.30 (24% exploitation), with a median spawning stock biomass level of 24,100 mt. Under Option 4 (quota capped at 8,400 mt in 1997), landings of 8,400 mt in 1996 provide a median F = 0.68 (45% exploitation), and landings in 1997 of 8,400 mt provide a median F = 0.42 (31% exploitation), with a median spawning stock biomass level of 22,500 mt. If the 1996 catch is underestimated, F in 1996 will be greater than projected under all options and available biomass in 1997 and 1998 will be lower than projected.

Forecast for 1996-1998

	Forecast medians (50% probability level) (landings, discards, and SSB in '000 mt)											
	1996				1997				1998			
Option	F_{96}	Land.	Disc.	SSB	F_{97}	Land.	Disc.	SSB	F_{98}	Land.	Disc.	SSB
1	0.52	8.4	1.9	23.4	0.30	9.3	0.8	33.2	0.23	10.2	0.6	45.9
2	0.52	8.4	1.9	23.4	0.27	8.4	0.7	33.9	0.23	10.4	0.6	46.8
3	0.68	8.4	1.9	16.4	0.30	6.4	0.6	24.1	0.23	7.5	0.6	35.8
4	0.68	8.4	1.9	16.4	0.42	8.4	0.9	22.5	0.23	6.9	0.6	33.6

Consequences/Implications

Option 1: Fishing mortality target in 1997 is F = 0.30 (24% exploitation). Projection uses SAW-22 stock sizes. Landings of 8,400 mt in 1996, F = 0.52 (37% exploitation); SSB increases 54% over 1995 estimate. Landings in 1997 can increase to 9,300 mt and meet F_{TGT} = 0.30 (24% exploitation). Landings can increase to 10,200 mt in 1998 and meet F_{TGT} = 0.23 (19% exploitation).

Option 2: Quota in 1997 is capped at 8,400 mt. Projection uses SAW-22 stock sizes. Landings of 8,400 mt in 1996, F = 0.52 (37% exploitation); SSB increases 54% over 1995 estimate. Landings in 1997 held at 8,400 mt and F is below F_{TGT} = 0.30 (24% exploitation). Landings can increase to 10,400 mt in 1998 and meet F_{TGT} = 0.23 (19% exploitation).

Option 3: Fishing mortality target in 1997 is F = 0.30 (24% exploitation). Projection uses SAW-22 stock sizes, REDUCED TO ACCOUNT FOR UNDERESTIMATION OF RECENT FISHING MORTALITY. Landings of 8,400 mt in 1996, F = 0.68 (45% exploitation); SSB increases 7% over 1995 estimate. Landings in 1997 must decrease to 6,350 mt to meet F_{TGT} = 0.30 (24% exploitation). Landings can increase to 7,500 mt in 1998 and meet F_{TGT} = 0.23 (19% exploitation).

Option 4: Quota in 1997 is capped at 8,400 mt. Projection uses SAW-22 stock sizes, REDUCED TO ACCOUNT FOR UNDERESTIMATION OF RECENT FISHING MORTALITY. Landings of 8,400 mt in 1996, F = 0.68 (45% exploitation); SSB increases 7% over 1995 estimate. Landings in 1997 held at 8,400, F exceeds F_{TGT} = 0.30 (24% exploitation). Landings must decrease to 6,900 mt in 1998 to meet F_{TGT} = 0.23.

Catch and Status Table (weights in '000 mt, recruitment in millions, arithmetic means): Summer Flounder

Year	1989	1990	1991	1992	1993	1994	1995	1996 Predicted	Max	Min (1982-1995)	Mean
Commercial landings	8.1	4.2	6.2	7.6	5.7	6.6	6.9	5.0	17.1	4.2	10.0
Commercial discards	0.7	1.2	1.1	0.9	0.7	0.9	0.9	0.9	1.2	0.7	0.9
Recreational landings	1.4	2.3	3.6	3.2	3.5	4.1	2.5	3.4	13.4	1.4	5.5
Recreational discards	0.1	0.6	1.1	0.9	1.8	1.4	1.9	1.0	1.8	0.1	1.1
Catch used in assessment	10.4	8.3	12.0	12.5	11.7	13.1	12.3	10.3	27.0	8.3	17.0
Spawning stock biomass[1]	5.2	7.5	5.8	7.0	8.3	9.9	15.2	23.4	18.9	5.2	11.6
Recruitment (age 0)	28.2	32.3	29.9	33.1	29.3	42.3	58.3	36.6	82.7	13.1	44.8
Mean F (ages 2-4,u)	1.8	1.2	1.7	2.1	1.3	1.3	1.5	0.5	2.1	1.0	1.5
Exploitation rate	78%	65%	76%	85%	67%	67%	72%	36%	85%	58%	72%

[1]At the peak of the spawning season (i.e., November 1).

Stock Distribution and Identification: A unit stock has been defined extending from Cape Hatteras north to New England. The Mid-Atlantic Fishery Management Council (MAFMC) and Atlantic States Marine Fisheries Commission (ASMFC) Fishery Management Plan defines the management unit as all summer flounder from the southern border of North Carolina northeast to the U.S.-Canadian border.

Catches: Recent commercial landings peaked in 1984 at 17,100 mt; recreational landings peaked in 1983 at 12,700 mt. During the late 1980s and into 1990, landings declined dramatically reaching 4,200 mt in the commercial fishery in 1990 and 1,400 mt in the recreational fishery in 1989. Reported 1995 landings in the commercial fishery used in the assessment were 6,897 mt, about 13% over the quota. Estimated 1995 landings in the recreational fishery were 2,496 mt, about 71% of the quota. If the 1996 landings quota is not exceeded (landings = 8,400 mt; expected total discards = 1,900 mt), total catch will be about 38% of the peak level reached in 1983 (Figure C1).

Data and Assessment: An analytical assessment (VPA) of commercial and recreational total catch at age (landings plus discards) was conducted. The natural mortality rate (M) was assumed to be 0.2. Information on recruitment and stock abundance developed from NEFSC winter, spring, and fall, Massachusetts spring and fall, Rhode Island fall, Connecticut spring and fall, and New Jersey trawl survey catch-per-tow-at-age data was used in the VPA tuning. Recruitment indices developed from young-of-year surveys conducted by the states of North Carolina, Virginia, Maryland, New Jersey, and Connecticut were also used in the VPA tuning. The uncertainty associated with the estimates of fishing mortality and spawning stock biomass in 1995 was evaluated with respect to research survey variability (Figures C5 and C6). Additional uncertainty in the assessment was present, but was not evaluated quantitatively due to inconsistencies between NEFSC and NCDMF ageing and potential underestimation of total catch.

Biological Reference Points: Biological reference points for summer flounder are based on a Thompson-Bell model, analyses from which in 1990 indicated that $F_{0.1} = 0.14$ (12% exploitation), $F_{MAX} = 0.23$ (19% exploitation), and $F_{20\%} = 0.27$ (22% exploitation) (Figure C3).

Fishing Mortality: Fishing mortality has been high, varying between 1.0 and 2.1 (58-85% exploitation) during 1982-1995 (Figure C1), well in excess of the overfishing definition, $F_{MAX} = 0.23$ (19% exploitation). The fishing mortality rate in 1994 was estimated to be 1.3 (67% exploitation), rising in 1995 to 1.5 (72% exploitation) (Figure C1). Based on the current assessment, if landings in 1996 are restricted to 8,400 mt as planned and discards total 1,900 mt (10,300 mt total catch), the 1996 F is expected to be about 0.52 (37% exploitation) (Figure C1). The SARC notes, however, that previous attempts to project future fishing mortality rates and stock size have not proven accurate.

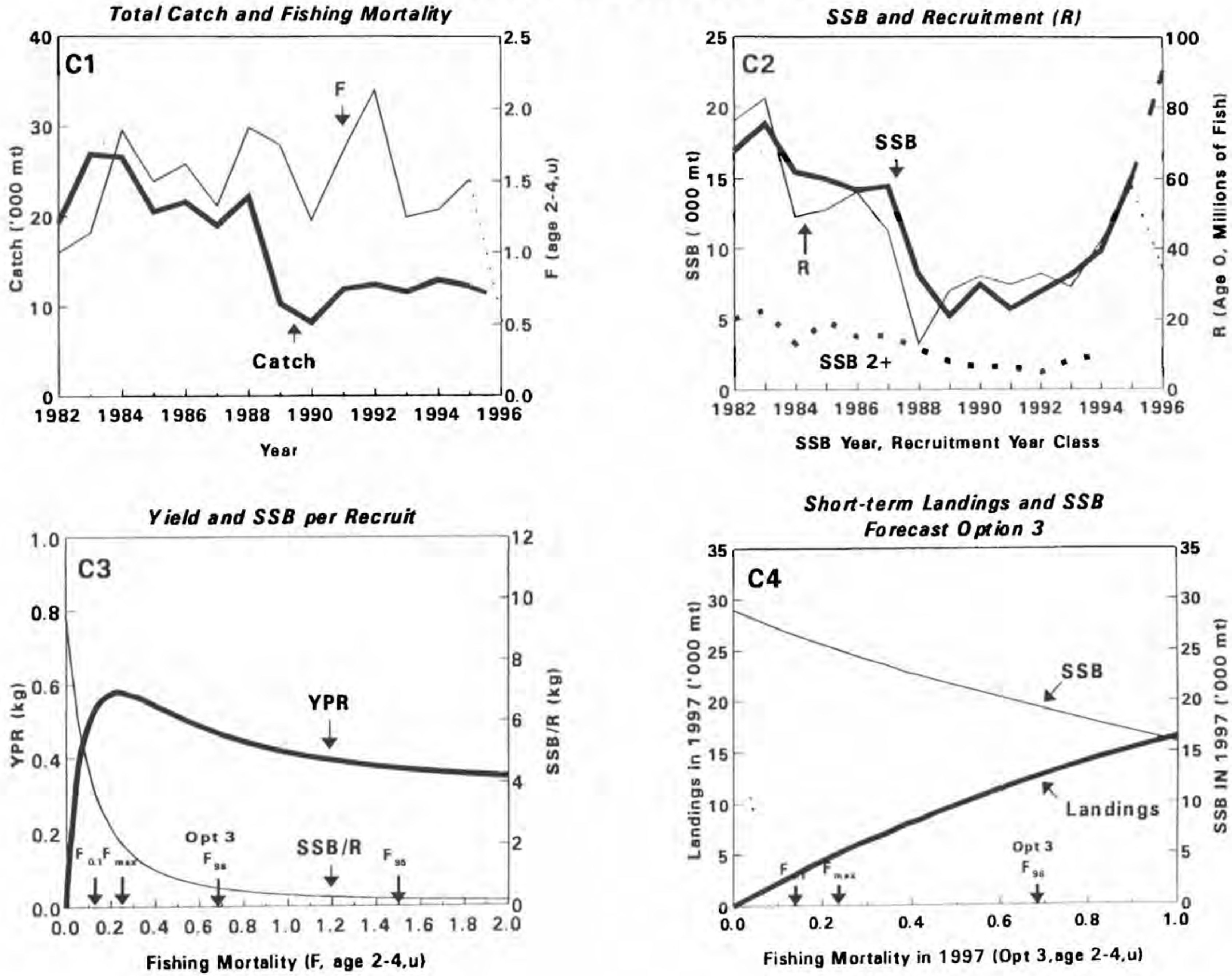
Recruitment: The 1982 and 1983 year classes are the largest in the VPA time series at 76 and 83 million fish, respectively. Recruitment declined from 1983 to 1988, with the 1988 year class the weakest at only 13 million fish. Recruitment since 1988 has generally improved (28 million in 1989, 32 million in 1990, 30 million in 1991, 33 million in 1992, 29 million in 1993, and 42 million in 1994). The 1995 year class, at about 58 million, is estimated to be the strongest since 1983 (83 million) (Figure C2).

Spawning Stock Biomass: Spawning stock biomass declined 72% from 1983 to 1989 (18,900 mt to 5,200 mt), but has since increased, as a result of improved recruitment, to 15,200 mt in 1995 (Figure C2). If the 1996 quota is not exceeded, spawning stock biomass should continue to increase through 1997. The age structure of the stock remains truncated in 1995 with only 5% of the spawning biomass composed of fish age 3 and older.

Special Comments: Given recent changes in fishery regulations (e.g., increases in mesh size and the imposition of trip limits in the commercial fishery), landings and discarding patterns should continue to be monitored so that future estimates of landings and discards will be reliable.

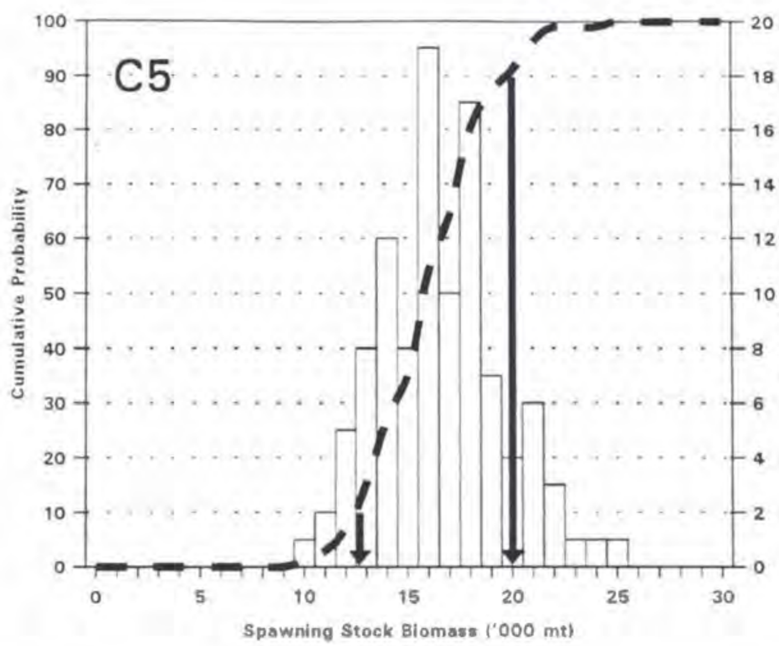
Sources of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13.

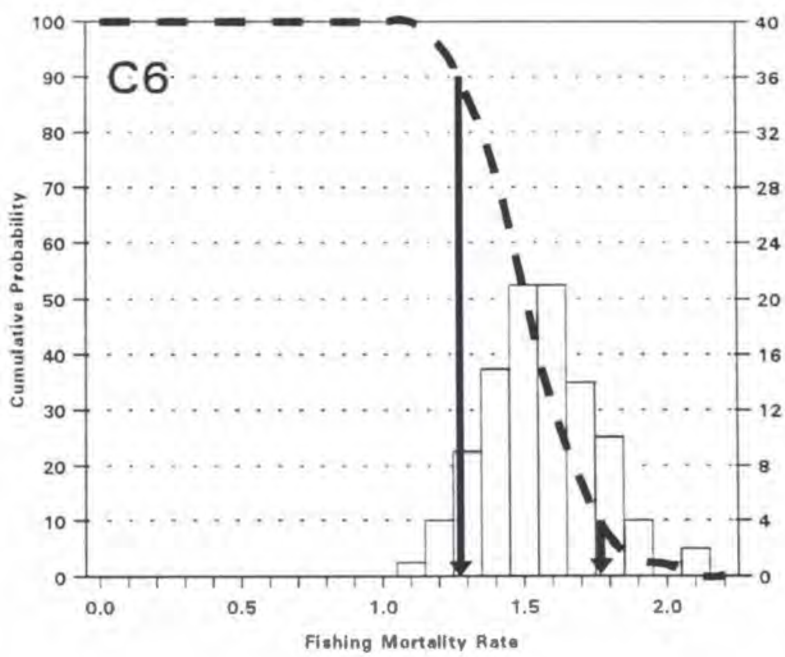
Summer Flounder



Summer Flounder

Precision of Estimates for SSB and F





D. SURFCLAM AND OCEAN QUAHOG ADVISORY REPORT

Management Advice: Two benchmarks are used for providing management advice on surfclams and ocean quahogs: 1) biological reference points relating to the overfishing definition (see: **Biological Reference Points**) and 2) 10-year (surfclam) or 30-year (ocean quahog) "supply years".

Surfclams

Growth information was used to update surfclam biological reference points (Figures D1 and D2) and projections of supply years (Figures D3-D6) that were reported in 1994 at SAW-19. Percent annual growth, in drained meat weight, was calculated to be 5.7% and 7.2% in the Northern New Jersey (NNJ) and Delmarva (DMV) regions, respectively. By including growth and revising the estimate of landings for 1994, the mean estimate of supply years for the NNJ region increased by approximately 1.2 years given recent catch levels (i.e., mean from 1992-1994). For the NNJ + DMV regions, the mean estimate of supply years increased by about 2.7 years. For both areas combined, a catch of 19,700 mt would meet the 10-year supply requirement; this catch level is similar to the 1995 and 1996 quotas. No additional surveys have been conducted since 1994, and this report does not present a revised stock assessment.

The SARC recommends that the current (i.e., 1996) surfclam quota be maintained until a new stock assessment is available with abundance estimates based on fishery catch rate and research survey data. The SARC noted problems with the survey-based DeLury model, but this does not necessarily imply that exploitable surfclam abundance is as high as estimated by the DeLury model based on catch rates or the 1994 swept-area biomass estimates. The current harvest level was adopted by the Council in 1995 based on declines in survey (1982-1992) and catch rate data (1986-1994) in addition to abundance estimates from DeLury models.

Ocean Quahogs

For ocean quahogs, the calculated growth rate of fully recruited individuals from the Long Island region (0.5 - 0.8% meat weight per year) was so low that it did not alter the conclusion that there is insufficient supply in the currently harvested areas to support the fishery for 30 years. A 30-year supply is possible only if the biomass on Georges Bank and in areas off Southern New England and Long Island, generally too deep to be harvested with current technology, are included. This strategy implies that sustainable fishing after 30 years will be limited to recruitment and very slow annual growth of fully recruited quahogs.

Forecast:

Surfclams

Calculations of the number of supply years of surfclam resource were updated from SAW-19 with a stochastic projection model which now includes growth. The model uses the same initial stock size estimates, general procedures, and assumptions as in the SAW-19 projections, but includes updated 1994 landings. The forecast table uses 1995 as year 1 and assumes constant harvest and average recruitment through time. Harvest levels in the forecast are at the average levels during 1992-1994, as well as those that would result in a 10-year supply with 50% probability.

Given the above assumptions, the following results were derived. Time to exhaustion of the resource under 1992-1994 fishing levels would be approximately 6 years (80% confidence interval = 4-7 years) for the NNJ region and 9 years for NNJ + DMV (80% confidence interval = 7-13 years). In DMV, recruitment is greater than removals and the harvests assumed are sustainable. Landings which would afford a 10-year supply for the NNJ region (14,150 mt/yr) are considerably lower than the average level from 1992-1994 (17,475 mt/yr). For the NNJ and DMV regions combined, the landings that would afford a 10-year supply (19,700 mt/yr) are slightly below the average landings during 1992-1994 (20,173 mt/yr).

Forecast table, revised to include annual growth in weight of exploitable surfclams (>119 mm)

Area	Landings basis	Landings option (mt/yr)	Assumed mean recruitment (mt/yr)	Growth rate of exploitable surfclams (annual %)	Supply years		
					Mean	Median	80% CI
NNJ	1992-1994 (mean)	17,475	7,259	5.67%	5.6	6	4 - 7
	10-yr supply	14,150	7,259	5.67%	10.0	10	8 - 13
DMV	1992-1994 (mean)	2,698	4,212	7.16%	100.0+	100 +	-
NNJ + DMV	1992-1994 (mean)	20,173	11,471	as above	9.4	9	7 - 13
	10-yr supply	19,700	11,471	as above	10.0	10	7 - 13

Ocean Quahogs

No new forecast was provided for ocean quahogs.

Biological Reference Points:

Surfclams

Revised reference points for surfclams differ very little from those reported at SAW-19. $F_{0.1}$ remained at 0.07 (7% exploitation) in the NNJ region and 0.08 (8% exploitation) in the DMV region. Revised estimates of F_{MAX} were 0.19 (17% exploitation) and 0.25 (22% exploitation) for NNJ and DMV, respectively. $F_{20\%MSP}$ was 0.18 (16% exploitation) for NNJ and 0.19 (17% exploitation) for DMV. The most recent estimates of F (from SAW-19 for 1993) are 0.20 (18% exploitation) for both NNJ and DMV. Localized exploitation rates for NNJ and DMV may overestimate the exploitation rate for the entire surfclam resource because some areas are not fished. Therefore, these rates are not directly comparable to the overfishing thresholds.

Ocean Quahogs

Ocean quahog reference points were not revised.

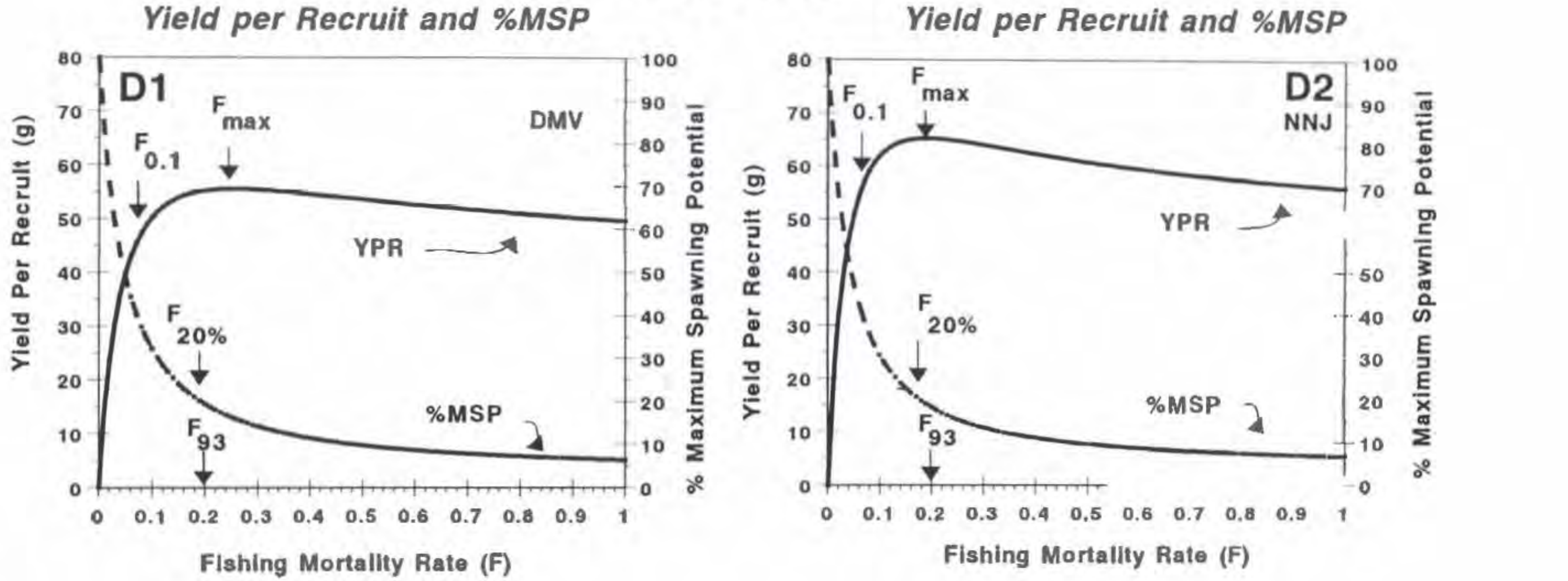
Special Comments: The SARC is uncertain about current abundance because 1) of problems with the survey-based DeLury model, 2) the fishery-catch-rate-based DeLury model used data from a limited area, and 3) survey data from 1994 were anomalous. The SARC proposes *status quo* management in 1997 because of the high level of uncertainty. An additional research survey will probably be conducted in 1997 and collaborative research with states, universities, and industry is similarly scheduled. Modifications to the model within the next year and new data in the next assessments will help resolve uncertainties.

Because the natural mortality rate of surfclams appears to be low (5% per year), little catch is forgone by delayed harvest. Biomass not harvested in one year will be available subsequently. Given current uncertainties about abundance, increases in catch levels could increase risks to the resource.

The SARC suggested that it may now be an appropriate time for the Council to revisit the question of appropriate harvest policies for surfclams. The approach used to calculate annual landings which would afford a 10-year supply employs assumptions about growth, natural mortality, and future recruitment. This approach may differ from the current harvest policy, which does not deal explicitly with these assumptions. The production dynamics of the surfclam fishery had previously been modelled as a mining strategy. Given estimates of growth and recruitment, it now appears that a sustainable fishery is feasible.

Sources of Information: 22nd Northeast Regional Stock Assessment Workshop (22nd SAW) Stock Assessment Review Committee (SARC) Consensus Summary of Assessments, NEFSC CRD 96-13 and Report of the 19th Northeast Regional Stock Assessment Workshop (19th SAW), The Plenary, NEFSC CRD 95-09.

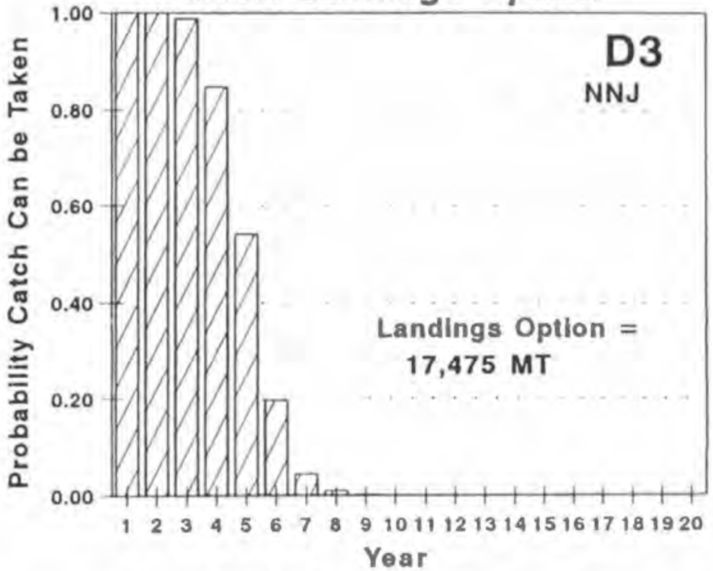
Surfclam



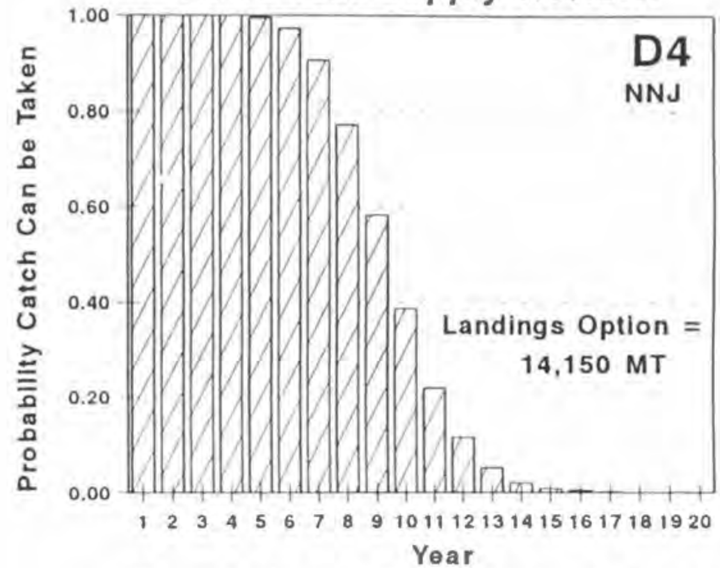
Yield per Recruit and %MSP
D1
DMV
F0.1
Fmax
F20%
F93
YPR
%MSP
Yield Per Recruit (g)
% Maximum Spawning Potential
Fishing Mortality Rate (F)
Yield per Recruit and %MSP
D2
NNJ
F0.1
Fmax
F20%
F93
YPR
%MSP
Yield Per Recruit (g)
% Maximum Spawning Potential
Fishing Mortality Rate (F)

Surfclam

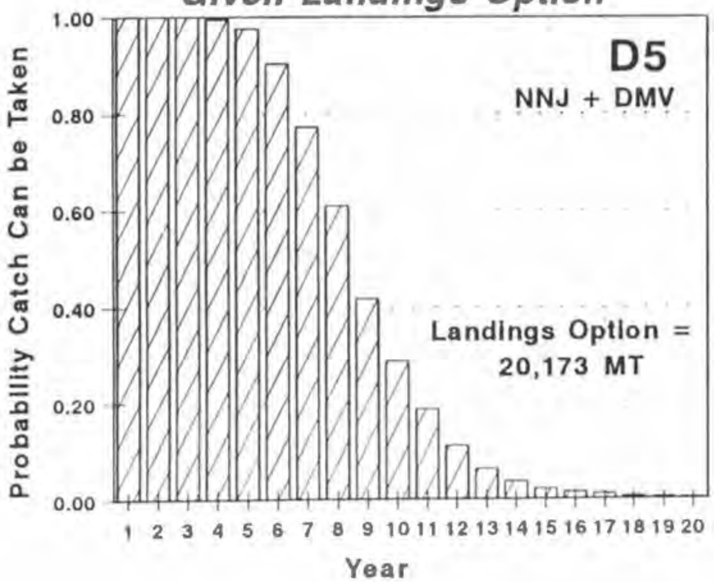
Supply Years From Fished Areas Given Landings Option



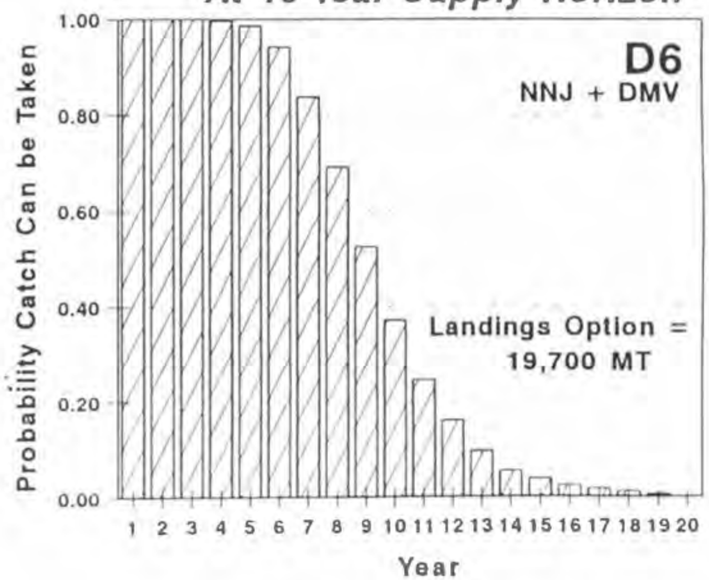
Supply Years From Fished Areas At 10-Year Supply Horizon



Supply Years From Fished Areas Given Landings Option



Supply Years From Fished Areas At 10-Year Supply Horizon



CONCLUSIONS OF THE SAW STEERING COMMITTEE

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

Teleconference of July 29, 1996

The SAW Steering Committee held a special meeting by teleconference on July 29, 1966. Participants were: J. Dunnigan, G. Lapointe, ASMFC; D. Keifer, T. Hoff, MAFMC; C. Kellogg, NEFMC; H. Goodale, NMFS/NER; M. Sissenwine, E. Anderson (SAW Chairman), S. Murawski, P. Rago, H. Mustafa (SAW Coordinator), NMFS/NEFSC.

Three issues were addressed during this teleconference: terms of reference for the next surfclam/ocean quahog analysis, consulting support for academic participants, and the NY lobster issue.

Terms of Reference for the next Surfclam/Ocean Quahog Analysis

To facilitate the start of work on research recommendations from SAW-22 for surfclam/ocean quahog, in preparation for the next assessment of these species at SAW-25, the SAW Steering Committee approved the following terms of reference:

1) Evaluate the efficiency of current research vessel dredge surveys through field studies of dredge tow path length, size selectivity and retention of surfclam and ocean quahog, and other factors, as appropriate.

2) Develop and implement a sampling plan for the proposed 1997 region-wide surfclam and ocean quahog resource survey, incorporating appropriate tests and monitoring of dredge efficiency.

3) Develop, test, and implement models to estimate surfclam and ocean quahog abundance and mortality rates, using appropriate indices of abundance and total catch.

4) Assess the status of EEZ surfclam and ocean quahog populations under management, and provide quota options consistent with biological reference points.

Proposed terms of reference for surfclam/ocean quahog had been reviewed at the MAFMC Surfclam and Ocean Quahog Workshop held July 23 and further discussed at the NEFSC. The second term of reference was slightly modified before submission to the Steering Committee. The Committee discussed the proposed change and fully agreed to the modification. There was general agreement that the Invertebrate Subcommittee needed to proceed with its work as soon as possible as it would take approximately 18 months to address all the terms of reference before the next surfclam/ocean quahog assessment anticipated for the fall of 1997 (SAW-25). SAW advice would have to be provided in time for the MAFMC to determine quota options in 1998. Subcommittee membership would include a small core group from the NEFSC, which would begin immediately, and possibly Eric Powell (Rutgers), Jeremy Collie (URI), Niels Moore (NFI), John Womack (Wallace & Associates) and others.

The availability of R/V *Delaware II* for SAW-related surfclam/ocean quahog work was discussed. Since the vessel was delayed at the shipyard and was scheduled for a high priority comparability study with R/V *Albatross IV*, it was unlikely that all work indicated in the terms of reference would be completed in the fall of 1996. Dr. Anderson was invited to discuss the *Delaware II* problem at the MAFMC meeting in August.

Consulting Support for Academic Participants

The importance of academic participation in the SAW process, the difficulty in obtaining such participants, and the need to provide consulting support for people from academia was discussed. Financial and policy implications of paying consulting fees, as well as reimbursement by industry, were considered.

A possible consulting agreement with a pool of perhaps 10 individuals to do needed work was also considered. A standard process to identify and involve a core group of competent individuals, outside of special interest groups, should be developed. It was recommended that a strawman process and/or suggestions on how to deal with the issue be drafted prior to the next Steering Committee meeting.

Although the issue of consultant fees was tabled during this teleconference, it was agreed to consider it again at the teleconference to be held the last week in August. It was felt that this topic might require an additional face-to-face meeting in light of the importance of the standard identification process and the need for it to be unbiased and transparent.

NY/CT Lobster Issue

A letter was discussed which the SAW Chairman and members of the Steering Committee had received from Gordon Colvin (NY) and Ernest Beckwith (CT), dated July 25, regarding their concern with the SAW-22 advice relative to the Long Island Sound lobster resource. The SAW analysis and the sensitivity of the NY egg-per-recruit model were discussed. In addition, Dr. Paul Rago, chairman of the Invertebrate Subcommittee, who had maintained communication with the NY lobster expert, provided the teleconference participants with a technical review of the issue. The difference between the SAW results and those from the NY model would not alter the SAW advice on lobsters. The NY expert had not attended either the Subcommittee or the SARC meetings, nor had any written documentation of the NY model and its results been made available during the SARC meeting. Dr. Rago would meet with the NY expert later that week, and if the analysis from that meeting would indicate a need to substantively change the advice, ASMFC could insist on another review at the next SAW.

It was agreed that the consensus advice of the SARC could not be changed. Dr. Anderson would provide a written response to Colvin and Beckwith and comment on the issue and the implication of any additional analyses during his presentation at the MAFMC meeting on August 7.

It was pointed out that the Colvin/Beckwith letter raised basic questions about the SAW process, such as how legitimate changes to the advice should be dealt with after a SARC meeting.

Teleconference of August 27, 1996

The SAW Steering Committee held a meeting by teleconference on August 27, 1996. Participants were: C. Kellogg, NEFMC; D. Keifer, MAFMC; J. Dunnigan, G. Lapointe, ASMFC; J. Rittgers, NMFS/NER; M. Sissenwine, F. Serchuk, E. Anderson (SAW Chairman), and H. Mustafa (SAW Coordinator), NMFS/NEFSC.

Dr. Emory Anderson, SAW Chairman, led the discussion of the agenda items.

Report on the SAW-22 Cycle

Dr. Anderson noted that all aspects of SAW-22 had been completed satisfactorily and that the recent Public Review Workshop sessions had gone well, with good question-and-answer sessions at both. The draft *Consensus Summary of Assessments* and *Advisory Report on Stock Status* distributed at the Workshop sessions were now in the process of final editing and would be finalized and printed early in the fall.

Follow-up to Teleconference of July 29, 1996

Terms of Reference for Surfclam/Ocean Quahog

The terms of reference approved at the July 29 teleconference would authorize the Invertebrate Subcommittee to begin addressing the problems with the dredge survey and the DeLury method and planning appropriate field work. Dr. Rago, Subcommittee chair, was planning to convene the first meeting on September 5 in Philadelphia. There had been further delays in the shipyard work on R/V *Delaware II* which would probably have implications for any field work with the clam dredge in the fall of 1996.

NY/CT Lobster Issue

The concerns raised by NY and CT following the SARC meeting in June relative to results of analyses of lobsters in the Central and Western Long Island Sound, particularly with respect to the egg-per-recruit model, appeared to be resolved, at least temporarily. A letter written by Dr. Anderson to Gordon Colvin (NY) and Ernest Beckwith (CT), in reply to their letter to him, had resulted in a one-day meeting between NEFSC, NY, and MA lobster experts during which useful discussions and analyses were completed leading to a better understanding of the sensitivity of the model to slight changes in the proportion of natural mortality assigned to the hard- and soft-shell components. Dr. Anderson had briefly made mention of these post-SARC analyses in his Public Review Workshop presentations. This issue would now need to be addressed by the ASMFC Lobster Technical Committee.

Support for Consultants at Subcommittee and SARC Meetings

It was agreed that this topic required more time for discussion than was possible during the present teleconference. This topic, as well as other issues relating to the SAW process, would be considered at a one-day, face-to-face meeting of the Steering Committee to be scheduled later in the fall.

SAW-23

Meeting Dates and Places

SARC meeting
November 18-22, 1996
Woods Hole

SAW Public Review Workshop
MAFMC and NEFMC January or February 1997 meetings (specific dates to be agreed at next Steering Committee meeting)

Topics

The species/stocks to be addressed at SAW-23 are goosefish, sea scallops, and bluefish. Mr. Rittgers reported on the status of the processing of 1994 and 1995 vessel logbook data. It was noted that the NEFMC Multispecies Monitoring Committee would be assessing the status of and providing TAC advice for the species included in the Northeast Multispecies FMP in early November 1996. Since this would involve a considerable workload, most of which would be borne by NEFSC assessment staff, it was agreed that it would be inappropriate to also include any of those stocks on the agenda for SAW-23. Consequently, Georges Bank cod and Georges Bank winter flounder were deferred until SAW-24.

The *Ad Hoc* Sea Sampling Working Group, established several years ago by the Steering Committee, had been inactive, and it was agreed to dissolve the Group. It was reported that the NEFSC was currently developing a strategy to identify a core sampling effort and intended to design a program which would meet scientific needs and have the flexibility to address management needs as well. Similar activities external to the Center (i.e., sea sampling conducted by states and academic institutions) should be integrated, to the extent possible, in any Center program.

Terms of Reference

The draft terms of reference circulated in advance of the teleconference were discussed. It was agreed to add another term of reference for bluefish relative to possible causes for the decline in bluefish abundance over the past decade or so. The appropriateness of the fourth term of reference for sea scallops was raised. After the importance of the impact of management measures on future assessments was explained, it was agreed to retain the term of reference.

Since the NEFMC staff had not had sufficient time to review the terms of reference, it was agreed to allow additional time for them to comment, after which the revised terms of reference would be distributed to Steering Committee members for approval.

Future SAW Meetings

SAW-24

SARC meeting
June 23-27, 1997

SAW Public Review Workshop
MAFMC and NEFMC August 1997 meetings

Candidate species/stocks
Summer flounder, scup, black sea bass, weakfish, Gulf of Maine cod, Georges Bank cod, Georges Bank winter flounder, Georges Bank haddock, Northern shrimp, lobster (Central and Western Long Island Sound area).

The need for future collaboration with Canada on the assessment and management of transboundary stocks (e.g., Georges Bank haddock) was noted.

SAW-25

SARC meeting
November 17-21, 1997

Terms of reference for surfclam/ocean quahog have been approved for SAW-25; no other candidate species/stocks were suggested. Table 2 lists the species/stocks considered at previous SAWs.

SAW Process

As noted above, this and other related topics were deferred for discussion at a face-to-face meeting of the Steering Committee later in the fall. Dr. Anderson commented very briefly on the status of industry representation at SARC meetings.

Table 2.

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						
COD, Georges Bank	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										
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																	
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																		
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			+																				
WHITE HAKE	X	X									X								X		+		
WOLFFISH	X																				+		

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