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Report of Third NEFC Stock Assessment Workshop (Third SAW)

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1. TERMS OF REFERENCE

During the Second Stock Assessment Workshop held at NEFC in May 1986 tentative scientific and management terms of reference for the Third Workshop were developed (described in the Report of the Second Stock Assessment Workshop, Woods Hole Lab. Ref. Doc. 86-09, pp. 102-107). Subsequently, additional terms of reference have been suggested, as well as deletions or postponements of topics. Based on this information, the following scientific and management terms of reference for the Third Stock Assessment Workshop (3rd SAW) are suggested.

Management Terms of Reference

1. Review the status of the stocks of surf clams, ocean quahogs, summer flounder, offshore American lobsters, bluefish, winter flounder, Atlantic cod, and pollock.

2. Review methods of measuring the long-term potential catch of fish resources to meet the requirements of the FCMA.

Scientific Terms of Reference

1. Review stock assessment research needs for bluefish, weakfish and for inshore stocks of American lobster, and review the status of information on the relationship between inshore and offshore lobsters.

2. Review research needs for methods of determining ages of bluefish.

3. Review progress of Working Groups established during the 2nd SAW:

    5. Experimental manipulation of fishing mortality on mackerel,
    6. Trawl survey design,
    7. Analysis of changes in catchability.

Fourth Status of Stocks Workshop

Select dates and develop scientific and management terms of reference for the 4th SAW.

2. OVERVIEW

Assessment information was presented by staff of the Northeast Fisheries Center, and staff of several state and academic institutions. The information to be presented ranged from complete revisions of previous assessments, to updates of previous assessments, to discussions of research needs. A report of the meeting was developed during the Workshop reflecting the participants' evaluation of material prepared in advance and of additional material developed in working groups during the Workshop. This report was based on a partial draft prepared in advance for consideration by the Workshop participants. That draft included an agenda, working text for the assessments being updated, and the summary sections of the draft revised assessment documents. The source documents for those assessments being updated and the draft assessment documents for those assessments being revised were also distributed.

Workshop participants modified the draft agenda (Section VIII.1), reviewed the draft report sections and the draft assessment documents, and developed revised text and new text reflecting the Workshop's discussions of adequacy of the information and of the needs for additional information (Sections II, III, and IV).

Three of the seven working groups established during the 2nd SAW agreed to continue their work after that Workshop. Status reports of those groups (WG-5, WG-6, WG-7), were presented (Section V.1, V.2, V.3), and future plans discussed. The Workshop agreed that WG-5 had not met its terms of reference in the short time available since the 2nd SAW, and recommended that it continue to function over the next several months. There was considerable discussion about the appropriateness of the charge, and it was emphasized that the focus was to be on the scientific basis for experimentally manipulating fishing mortality.

The Workshop agreed that WG-6 had met most of its terms of reference, and that further work could best be handled separately by interested parties. The Workshop agreed that WG-7 had not yet met its terms of reference, and noted that suitable definition of fishing effort may be a limitation. The Workhop Chair was asked to confer directly with the Chairman of that working group about specific plans. Additional working groups were needed during this Workshop to address specific items in greater detail than is possible in plenary session.

Two specific working groups were identified in advance, one on bluefish ageing techniques and a second on methods of measuring long-term potential catch. Draft terms of reference were reviewed, and the bluefish ageing working group (WG-8) met during the Workshop. Their report was accepted by the Workshop (Section V.4) and the working group disbanded.

Methods of measuring long-term potential catch were discussed (Section VI.1), and terms of reference for a working group to discuss such methods were developed (WG-9) during the workshop. A group was asked to report back during the next Workshop (Section V.5).

Scientific and management terms of reference for subsequent stock assessment workshops were discussed (Section VI.2), and terms were recommended for a workshop to be held March 30 - April 3, 1987 (Section VI.3) in Woods Hole, Massachusetts.

1. SURF CLAM

Source Document: Murawski, Steven A. 1986. Assessment updates for Middle Atlantic, New England, and Georges Bank Offshore Surf Clam, *Spisula solidissima* populations, summer 1986 - IN REVIEW. Woods Hole Lab. Ref. Doc. No.

Summary: This report provides an updated status review for Middle Atlantic Southern New England, and Georges Bank FCZ surf clam, *Spisula solidissima*, populations (through August 1986) based on commercial vessel logbook data and catch sampling and results of research vessel surveys conducted by the Northeast Fisheries Center.

Landings of surf clams during 1985 increased to 72.5 million pounds of meats, up 3% from the 1984 level of 70.2 million pounds. The proportion of the total taken from the Fishery Conservation Zone (FCZ) decreased slightly for the second straight year, from 78% in 1984 to 72% in 1985. Total FCZ landings as of 25 August 1986 were 33.9 million pounds, accounting for 63% of the total annual quotas for the three FCZ management areas (Middle Atlantic, Southern New England, Georges Bank), taken during 65% of the calendar year. Landings from state waters (primarily New Jersey and New York) increased 30% from 1984 (15.6 million pounds) to 1985 (20.3 million pounds). Much of the 1985 increase in state landings was due to the rapid development of the nearshore fishery in Long Island Sound, New York.

Catch per unit effort (CPUE), in bushels per hour fishing) continued to increase in all Middle Atlantic assessment areas throughout 1985 and in 1986. Average CPUE over all vessel size classes increased 110% during 1984-1985, from 77 to 162 bushels per hour. CPUE off Southern New England and Georges Bank declined between 1984 and 1985, 11% and 32% respectively. Average CPUE in 1986 increased slightly off Southern New England and nearly doubled for all vessel classes on Georges Bank. Much of the acceleration in CPUE for the Middle Atlantic assessment areas was due to the decrease in the minimum size limit (to 5" shell length) and the continued high abundance of strong year classes in Northern New Jersey and Delmarva regions.

Research vessel survey data for 1986 indicate continued strong 1976 and 1977 year classes off Northern New Jersey and Delmarva, respectively. However, year classes spawned since 1977 have been relatively weak in the Middle Atlantic Bight. Abundance of surf clams off New Jersey has declined as indicated by research vessel survey indices since 1982, due to the concentration of the Middle Atlantic Fishery in that area in recent years. Abundance off Delmarva and Southern Virginia-North Carolina has remained stable in the past several years. Research vessel survey data for the Middle Atlantic region indicate adequate surf clam resources in that region to support the Middle Atlantic FCZ fishery at or near current levels (40-50 million pounds of meats per year) until the mid-1990's.

Resources off Southern New England and Georges Bank comprised 5% and 14% respectively of the entire region-wide resource in the August 1986 NEFC surf clam survey. Current annual quotas in both areas (3.4 and 5.1 million pounds

respectively) will result in relatively stable stock biomass between 1986-1987. Adequate resources exist in both areas to sustain these quota levels into the 1990's.

Discussion

Extensive discussion followed the presentation of the source document, focused mainly on the two broad areas of density dependent growth and NMFS survey variability and its value in detecting impacts of fishing mortality. The existence of density dependent growth in surf clams was suggested by Murawski and Fogarty (1984). They noted that the previously predicted growth, based on the mean size at age curves, was not being attained. The current high densities are attributable to the two very strong year classes off of Northern New Jersey (1976) and Delmarva (1977) which totally dominate the fishery and the resource. Previously estimated growth curves projected that the average size clam would have reached 5.5" by its seventh year, but the 1986 survey length frequencies show that these lengths still have not been attained. It appears that growth of the Delmarva resource has considerably slowed down and the effect of density dependent growth is most detectable in this area.

Density dependent growth, of course, is hard to quantify when fishing mortality with minimum size limits crop off the faster growing individuals. There was discussion on the occurrence of density dependent survival, and on the anoxia caused predator reduction being the cause for the strong 1976 year class in northern New Jersey. The effects of these differences in growth need to be extensively evaluated. Currently, there is speculation whether these differences would significantly affect interpretation of scientific and management tools such as yield per recruit.

The issue of survey variability stems from the apparent four year decreasing trend in the stratified mean number per tow for northern New Jersey (Table II.1.1). Variability estimates (standard deviation or coefficient of variability) are needed to evaluate if these differences are significant. There was concern that if the trend is significant then fishing mortalitites are becoming very significant and may provide the impetus to more fully evaluate existing and/or proposed harvesting strategies.

Other points discussed relative to the source document were: (1) discarding is at a 5 year low of 16%, (2) no 1987 survey is scheduled and since clams need to be two years old to be adequately sampled by survey gear, any recruitment of 1985 or 1986 year classes will be unknown for two years, (3) two new "super" class III vessels which can land up to 5000 bushels per trip and tow 20-foot dredges are currently fishing Georges Bank, (4) empty shells with hinge intact ("boxes") probably do not last a full year as previously believed, and (5) natural mortality may be 0.1 for clams older than age 1.

Mid-Atlantic Council staff presented the 1986 survey results of the three closed areas. Very slow growth rates in these areas were observed, and it is unlikely that the current reopening criteria of the majority of clams being

over 5.5" will be met in the near future. Since growth rates have slowed and the mean size of all three areas currently exceed the size of maximum yield per recruit (4.75"), there may be no reason to continue the closures. It must be remembered, however, that although the mean size exceeds that which provides maximum yield per recruit, not all clams are larger than that size. Thus, if 50% of the clams are above the current legal size half are not legal size and will either be discarded or landed undersized. It was suggested that since not all sizes are present in all locations (there is a heterogenity in the length frequencies at different stations in the closed areas) that fishermen may be able to minimize discarding by fishing at sites with the largest sizes of clams.

New York DEC staff summarized the Long Island Sound surf clam fishery in the fall 1985 and winter 1986. Approximately one half a million bushels were landed by upwards of 50 vessels in that 6- month period. Currently there are no significant quantities of clams over 4 inches in significant quantities. There is limited survey work showing some extensive beds of 3" clams but no market exists and thus their harvest is currently unlikely.

Table II.1.1. Stratified mean number and weight (meats only, kg) per tow of surf clams from NMFS surveys off northern New Jersey, 1965-1986. Data are standardized to a 60" wide dredge towed for five minutes.

	Total index		<5"		<5"		% 5"	
Survey	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight
May 1965	38.07	4.79	15.44	1.17	22.62	3.62	59.4	75.6
Oct 1965	35.73	5.27	6.18	0.51	29.55	4.76	82.7	90.3
Aug 1966	30.44	4.51	5.44	0.36	24.99	4.15	82.1	92.1
Jun 1969	34.26	5.37	3.93	0.30	30.33	5.07	88.5	94.4
Aug 1970	25.73	4.12	4.84	0.30	20.89	3.82	81.2	92.9
Jun 1974	21.40	3.37	2.75	0.19	18.66	3.17	87.2	94.3
Apr 1976	12.92	2.06	2.39	0.12	10.53	1.93	81.5	94.0
Jan 1977	2.45	0.23	1.39	0.05	1.06	0.19	43.2	81.4
Jan 1978	2.06	0.16	1.48	-.06	0.58	0.11	28.3	64.9
Dec 1978	44.88	1.20	43.85	1.03	1.01	0.17	2.3	14.8
Jan 1980	31.70	1.95	27.52	1.22	4.17	0.75	13.2	38.1
Aug 1980	53.56	3.74	50.66	3.24	2.90	0.50	5.4	13.5
Aug 1981	39.10	3.23	31.15	2.04	8.03	1.19	20.5	36.0
Aug 1982	112.79	8.78	101.53	7.11	11.26	1.67	9.9	19.0
Aug 1983	72.91	5.94	63.06	4.42	9.85	1.52	13.5	25.6
Jul 1984	64.88	5.47	52.71	3.70	12.17	1.77	18.8	32.3
Jun 1886	45.57	4.57	30.81	2.37	14.76	2.20	32.4	48.1

2. Ocean Quahog

Source Document: Murawski, S. A. and F. M. Serchuk. 1983. An Assessment of the Ocean Quahog, *Artica islandica*, Resource and Fishery in FCZ Waters off the Northeastern USA - Autumn 1983. NMFS NEFC, Woods Hole Lab. Ref. Doc. No. 83-25. 31 p.

Fishery:

Landings of ocean quahogs in 1985 increased to 52.0 million pounds, up 34% from the 1984 total of 38.8 million pounds (Table II.2.1). Landings in 1985 established record totals both for quantity and value of the catch. Virtually all 1985 catches were derived from the Fishery Conservation Zone (FCZ), with small quantities landed from inshore waters off Rhode Island and Maine. The largest fraction of commercial landings (>90%) are derived from off New Jersey and the Delmarva Peninsula, with Delmarva currently accounting for 58% of the 1986 year to date Middle Atlantic landings, and New Jersey 42% (Tables 2 and 3).

Vessel class 3 (≥101 +GRT) currently accounts for about 90% of ocean quahogs landed from the FCZ. The remainder is landed by class 2 vessels (51-100 GRT), primarily off New Jersey. CPUE time series for class 2 and 3 vessels operating off New Jersey and Delmarva are updated through the third quarter of 1986 in Tables II.2.2 and II.2.3. Quarterly CPUE values for New Jersey have generally fluctuated without trend for both class 2 and class 3 vessels. Initial (1978 - 1980) high CPUE values for class 2 vessels were not sustained, but this is probably the result of sparse data and changing fleet composition rather than region-wide changes in quahog abundance. Likewise, CPUE indices for class 2 and 3 vessels off Delmarva have generally exhibited little trend over time, although class 2 indices have increased somewhat in the past 3 years.

Results of the June - July 1986 NEFC ocean clam assessment cruise are summarized in Tables II.2.4 and II.2.5. Survey abundance indices were developed for six assessment areas off the northeastern USA: Southern Virginia-North Carolina (SVA-NC), Delmarva (DMV), New Jersey (NJ), Long Island (LI), Southern New England (SNE), and Georges Bank (GBK). Abundance indices in numbers per tow for each of the six areas are given in Table II.2.4. These results are essentially the same as indices developed from combined survey results for 1980-1982 (Murawski and Serchuk 1983):

Area	Number Per Tow Index 1980 - 1982	1986	Percent Change
SVA-NC	0.56	0.18	-68
DMV	47.63	43.57	- 9
NJ	99.16	117.05	+18
LI	245.78	243.51	- 1
SNE	230.56	208.65	-10
GBK	213.37	197.80	- 7

Catch per tow at length for both surveys indicate no significant change in resource abundance for these two regions as a whole, although slight growth as evidenced by a right-hand shift of length frequency modes between 1980 - 1982 and 1986 surveys is indicated for each area.

Minimum biomass estimates were calculated by expanding the average catch per tow values (in meat weight) for each area by the area swept by an average dredge tow (0.0001069 n. miles^2), then multiplying by the area surveyed corresponding to the catch per tow index in each assessment area (Table II.2.5). Again, these calculations are very consistent with similar analyses from 1980 - 1982 surveys:

Area	Minimum Population Estimates (Millions of Pounds) 1980 - 1982	1986	Percent Change
SVA	3.41	0.45	-87
DMV	198.41	184.69	- 7
NJ	511.52	600.10	17
LI	499.77	605.61	21
SNE	693.01	571.19	-18
GBK	762.77	615.47	-19
Total	2,668.90	2,577.50	- 3

The total minimum population estimate for all six areas combined was 3% less for the 1986 survey than the 1980 - 1982 value. Considering that the 1986 clam survey evaluated about 7% less area, the survey abundance indices between years were not significantly different.

The proportions of total resource biomass in each area also changed little between surveys (Murawski and Serchuk 1983).

Current harvest quotas for the FCZ ocean quahog fishery (60 million pounds of meats) are approximately 2% of the minimum biomass estimate for the six assessment areas evaluated during NEFC surveys. Considering this low relative exploitation rate, total resources will remain stable for the next several years, although the distribution of fishery landings remains very much different than that of the resource as a whole. The 1986 survey revealed no significant increases in ocean quahog recruitment to any assessment area, thus in the long-term stock biomass in areas currently being exploited (New Jersey, Delmarva) will be reduced.

Discussion:

The estimated current exploitation rate is approximately 2% of the minimum biomass estimate from resource surveys. In the absence of significant density dependent responses of growth and recruitment (current growth rates are extremely slow and recruitment is very poor), the fishery could be sustained at approximately current levels for the next 50 years. Research is obviously needed on density influences on growth and recruitment rates, as well as on methods for estimating long-term yield from ocean quahog stocks.

Current survey and growth studies are designed to monitor density and growth/ recruitment responses in those areas subject to intensive fishing (New Jersey and Delmarva) as well as stocks in areas of virgin resources. Workshop participants discussed several potential experimental and monitoring approaches for analyzing the potential for density-dependent population regulation processes affecting productivity of ocean quahog populations.

Table II.2.1. Landings of ocean quahog (thousands of pounds of meats) from state waters and the Fishery Conservation Zone (FCZ), 1967-1986.

Year	State Waters	FCZ	Total	Percent FCZ
1967	44	-	44	0
1968	225	-	225	0
1969	639	-	639	0
1970	1,746	-	1,746	0
1971	2,030	-	2,030	0
1972	1,399	-	1,399	0
1973	1,457	-	1,457	0
1974	805	-	805	0
1975	1,254	-	1,254	0
1976	1,446	4,089	5,535	74
1977	2,465	16,082	18,547	87
1978	2,686	20,279	22,965	88
1979	3,095	31,629	34,724	91
1980	3,215	30,617	33,832	90
1981	903	35,204	36,107	97
1982	456	34,336	34,792	99
1983	1,545	33,687	35,232	96
1984	2,647	36,165	38,812	93
1985	-	51,964	51,964	>99[2]
1986[1]	-	23,069	-	-

[1]FCZ totals through 3 September 1986, based on vessel trip logbook reports.

[2]Some inshore landings of ocean quahogs occurred from Maine coastal waters during 1985, however the magnitude of this fishery was relatively small, and catch statistics are not available.

Table II.2.2. Commercial ocean quahog catch and effort statistics for the New Jersey assessment area, 1983-1986. Data are presented by calendar quarter for each of three vessel size classes (see text) and were derived from vessel trip logbook reports.

		Number of Trips Analyzed Vessel Class			Total Catch (Hundreds of Bushels) Vessel Class			Total Hours Fished Vessel Class			Mean Bushels/hour Vessel Class		
Year	Quarter	1	2	3	1	2	3	1	2	3	1	2	3
1983	1	-	11	198	-	57	2307	-	70	2001	-	81	115
	2	-	16	193	-	83	2257	-	80	2052	-	104	110
	3	-	15	97	-	108	1194	-	126	875	-	86	136
	4	-	13	111	-	91	1585	-	109	1154	-	83	137
	Total	-	55	599	-	339	7343	-	385	6082	-	88	121
1984	1	-	33	199	-	279	2275	-	329	1718	-	85	132
	2	-	54	149	-	466	1684	-	505	1451	-	92	116
	3	-	65	170	-	518	1873	-	593	1823	-	87	103
	4	-	61	181	-	473	1920	-	532	1721	-	89	112
	Total	-	213	699	-	1736	7752	-	1959	6713	-	89	115
1985	1	-	48	128	-	388	1327	-	405	1144	-	96	116
	2	-	54	279	-	476	3134	-	458	2341	-	104	134
	3	-	76	338	-	593	4112	-	659	3088	-	90	133
	4	-	14	198	-	100	2610	-	103	1853	-	97	141
	Total	-	192	943	-	1557	11182	-	1625	8425	-	96	133
1986	1	-	27	258	-	225	3304	-	250	2207	-	90	150
	2	-	26	260	-	194	3358	-	245	2304	-	79	246
	3[1]	-	31	103	-	283	1279	-	289	1056	-	98	121
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	84	621	-	702	7941	-	784	5567	-	90	143

[1]Data from vessel logbooks through 3 September 1986.

Table II.2.3. Commercial ocean quahog catch and effort statistics for the Delmarva assessment area, 1983-1986. Data are presented by calendar quarter for each of three vessel size classes (see text) and were derived from vessel trip logbook reports.

		Number of Trips Analyzed Vessel Class			Total Catch (Hundreds of Bushels) Vessel Class			Total Hours Fished Vessel Class			Mean Bushels/Hour Vessel Class		
Year	Quarter	1	2	3	1	2	3	1	2	3	1	2	3
1983	1	-	36	268	-	277	3670	-	371	2244	-	75	164
	2	-	24	333	-	179	4954	-	231	3050	-	77	162
	3	-	39	455	-	264	6260	-	328	4008	-	80	156
	4	-	36	402	-	287	5281	-	392	3466	-	73	152
	Total	-	135	1458	-	1007	20165	-	1322	12768	-	76	158
1984	1	-	9	390	-	65	5239	-	89	3561	-	73	147
	2	1	4	506	3	28	6686	9	35	4863	33	80	137
	3	-	16	350	-	112	4302	-	124	3311	-	90	130
	4	-	11	503	-	89	6944	-	80	4589	-	111	151
	Total	1	40	1749	3	294	23170	9	328	16324	-	90	142
1985	1	-	7	372	-	51	5348	-	39	3192	-	131	168
	2	-	27	678	-	182	9347	-	169	6042	-	108	155
	3	-	39	511	-	310	6723	-	272	5017	-	114	134
	4	-	36	269	-	278	3809	-	270	2764	-	103	138
	Total		109	1830	-	821	25227	-	750	17015	-	109	148
1986	1	-	51	260	-	447	3377	-	451	2487	-	99	136
	2	-	62	343	-	646	4997	-	590	3431	-	109	146
	3[1]	-	19	167	-	214	2379	-	184	1600	-	116	143
	4	-	-	-	-	-	-	-	-	-	-	-	-
	Total	-	132	770	-	1307	10753	-	1225	7578	-	107	142

[1]Data from vessel logbooks through September 1986.

Table II.2.4 Abundance (stratified mean number per tow) of ocean quahogs from six FCZ assessment areas off the northeast United States, from the 1986 ocean clam survey conducted by NEFC. A standard survey tow was of 5 minutes duration with a 1.5 m (60") wide hydraulic clam dredge.

Area	Number Per Tow	Number of Tows	Area of Sampled Strata	Abundance (Number per Tow) by Size Interval (mm)												
				20-24	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100-109	110-119	120-129	130-139	140-149
Southern Va.-North Carolina	0.18	25	2805								0.11	0.07				
Delmarva	43.57	76	5715				0.09	0.25	5.82	13.87	14.81	6.44	2.12	0.16		
New Jersey	117.05	105	6856		0.02	0.08	0.01	1.21	5.86	27.82	53.13	23.79	4.66	0.38	0.08	
Long Island	243.51	38	4478	0.04		0.29	0.68	21.63	58.79	59.36	73.21	25.66	3.77	0.08		
Southern New England	208.65	28	5141				2.75	11.47	44.99	78.95	58.21	11.61	0.66			
Georges Bank	197.80	63	7243		0.05	0.02	4.50	22.37	82.35	67.50	18.99	1.85	0.18			

Table II.2.5. Minimum ocean quahog population estimates (meat weight, metric tons and pounds) in each of six Northwest Atlantic assessment areas. Estimates are based on areal expansion of 1986 survey catch per tow data.

Assessment Region	Area Surveyed ($n.m.^2$)	Mean Catch Per Tow (kg.)	Population Estimates (MT)	(Millions of Pounds)	Percent of Total
Southern Virginia-North Carolina	2,805	0.0077	202	0.45	0.02
Delmarva	5,715	1.5667	83,758	184.69	7.17
New Jersey	6,856	4.2435	272,156	600.10	23.28
Long Island	4,478	6.5566	274,653	605.61	23.50
Southern New England	5,141	5.3864	259,041	571.19	22.16
Georges Bank	7,243	4.1196	279,123	615.47	23.88
Total	32,238		1,168,933	2,577.50	100.01

1. SUMMER FLOUNDER

Source document: Fogarty, Michael J. 1981. A review and assessment of the summer flounder (Paralichthys dentatus) fishery in the Northwest Atlantic. NMFS, NEFC, Woods Hole Lab.Ref. Doc. No. 81-25, 54 p.

The Fisheries

Commercial Fishery Trends

Nominal U.S. commercial catches of summer flounder from Georges Bank to Cape Hatteras remained relatively stable at an average of approximately 3,600 mt per year from 1963 to 1973, and then increased steadily to approximately 10,800 mt in 1976 (Table II.1.1). Since then, commercial landings have fluctuated widely, from a low of approximately 7,800 mt in 1981 to peaks of over 14,000 mt in 1979 and 1984. A breakdown of U.S. commercial landings by state is given in Table III.1.2.

Recreational Fishery Trends

Surveys of the recreational fisheries of the U.S. have been conducted annually by NMFS since 1979. Recreational catch is reported as "Type A" (harvested fish available for identification by survey personnel) or "Type B" (fish not available for identification). Type B catch is further subdivided into Type B1, fish utilized for fillets, bait, etc. or released dead, and Type B2, fish released alive. The sum of catch Types A and B1 represent the total recreational harvest for a species. Estimates of all three catch types are available in numbers, however direct estimates of catch in weight are available only for catch Type A.

Estimates of the recreational harvest in numbers of summer flounder averaged 20,732,000 in 1979-1980, declined to 11,383,000 in 1981-1982, and increased again to 24,815,000 in 1983-1984 (Table III.1.3). The 1985 estimated recreational harvest in numbers was 13,225,000. Coefficients of variation about the estimates averaged 25% for the North Atlantic and 15% for the Middle Atlantic over the seven year time period (Table III.1.4). Estimates of the number of summer flounder released alive (catch Type B2) averaged 27% of the estimates of the number harvested (Type A + B1) during 1979-1985 (Table III.1.3).

Catch per unit of effort indices were derived using the number of directed summer flounder trips as a measure of effort. Although this undoubtedly underestimates actual effort on summer flounder, it allows comparisons of trends. Catch per unit of effort was higher in the Middle Atlantic than in the North Atlantic for every year except 1982 (Table III.1.5). Changes over time in the two areas show no clear trends with respect to each other. For the total area, CPUE was high during 1979-1980, dropped during 1981-1982, and increased to its former levels during 1983-1985.

Estimates of the total recreational harvest in weight were generated to allow comparisons with commercial landings. Recreational landings in weight were estimated by expanding the weight of catch Type A by the proportion of

Type B1 catch to Type A catch and assuming that the size (weight) distribution of Type B1 fish was the same as that of Type A fish. The recreational harvest accounted for 37% (1985) to 57% (1983) of the total landings of summer flounder (Table III.1.6).

Abundance Indices

Research Vessel Surveys

Bottom trawl surveys conducted by NMFS during the spring in offshore waters of the Middle Atlantic Bight and on Georges Bank were used to provide indices of abundance for summer flounder. Spring surveys were considered the most reliable indicators of biomass because summer flounder are concentrated in offshore areas during spring surveys and are more consistently available to the gear than in the fall. The delta distribution stratified mean catch per tow was relatively low during the late 1960's and early 1970's, increased during the mid-1970's and then declined again during the late 1970's and early 1980's (Tables III.1.7 and III.1.8). Considerable fluctuations have been evident since 1978. 1985 and 1986 survey indices were higher than 1983 and 1984 levels. Caution is necessary in interpreting the 1985-86 survey data however since a change in trawl door was made in 1985. Preliminary analyses for experiments made to calibrate trawl performance with the new doors indicates a significant increase in gear efficiency for all species combined with the new door type (J. Forrester, per. comm). Catches of summer flounder during the experiments were too low to allow evaluation of the effects of door type specifically on summer flounder.

A smoothed index (Pennington 1985) for the survey catch per tow was constructed and used as the index of relative abundance. The method involves development of a time series model for the stratified mean catch-per-tow to filter measurement error (changes in catchability) from changes in population abundance. See Pennington (1985) for a full description and rationale for the approach.

Commercial Catch and Effort

Commercial catch per unit effort (days fished) indices were calculated for tonnage classes 2, 3 and 4 otter trawlers (5-50 gross tons, 51-150 gross tons, and 151-500 gross tons, respectively) for trips in which 5% or greater of the catch was comprised of summer flounder. Catch per unit effort was similar for all three vessel classes from 1967 through 1975. After 1975, similar trends in CPUE are evident, however tonnage classes 3 and 4 show significantly higher CPUE than tonnage class 2 (Table III.1.9). Rank order correlations between NMFS survey indices and CPUE for the three tonnage classes were highest for tonnage class 2 vessels ($r=0.62$) and lower for tonnage class 3 ($r=0.40$) and tonnage class 4 ($r=.47$) vessels.

Catch per effort for tonnage class 2 vessels ranged from a low of 0.44 in 1970 to a high of 1.20 in 1974. CPUE remained relatively constant from 1977 through 1982, increased slightly in 1983 and 1984, and then declined to its lowest level since 1972 in 1985 (Table III.1.9).

Catch at Age

The stratified mean number per tow at age for the spring offshore surveys from 1976-1986 was dominated by ages 1, 2 and 3 (Figure III.1.1, Table III.1.10). The proportion of one year olds (.51) was high in 1986 suggesting the possibility of a strong year class. In 1985, the proportion of age one fish was very low (.05), suggesting poor recruitment of the 1984 year class.

Estimates of catch at age for commercial landings were available for 1976-1983 (Figure III.1.2, Table III.1.11). Ages 1 through 4 comprised 94% of the landings, with ages 2 and 3 predominating (45% and 29% of the total catch, respectively). During 1980-1983, the contributions of age 3 and age 4 fish declined from 49% to 28%, while the proportions of age 1 and age 2 fish increased from 46% to 66%.

Growth

Parameters of the von Bertalanffy growth equation were fitted to length at age data for male and female summer flounder from NMFS spring (offshore) and fall (inshore and offshore) bottom trawl surveys from Georges Bank to Cape Hatteras during 1976 through 1983. Age determinations for 1,947 males and 2,030 females were available from these surveys. Ages were adjusted to reflect time of capture (spring or fall) relative to a January 1 birthdate assigned by convention. The growth curves were fit for each sex using non-linear least squares regression of mean length on age. Attempts to fit the curves using the raw data rather than means resulted in unreasonable parameter estimates.

The predicted asymptotic size for females (82.67 cm TL) is larger than for males (67.49 cm TL) (Table III.1.12) but is smaller than others values reported for females in the literature (88-94 cm, see Source Document). The value obtained for males is comparable to other reports which range from 60.7 cm - 73 cm. Values of the Brody growth coefficent (k) are comparable to those calculated in the Source Document using data which included both inshore and offshore collections.

Total Mortality

Estimates of total mortality (Z) were derived for the 1973 through 1981 year classes using regression analysis of catch curves. Catch at age information from the commercial fishery and the spring offshore surveys was used to estimate mortality.

Age composition data were available for spring surveys from 1976 through 1983; provisional age determinations also have been made for for a limited number of samples from fall surveys conducted in 1984 (n=154) and 1985 (n=147). Mean catch per tow was calculated using the smoothed survey index. The smoothed index was used to minimize fluctuations between years caused by random changes in catchability and thus allow more reliable tracking of cohorts. Catch per tow at age for spring offshore surveys from 1976 through 1983 was calculated by expanding length frequency data from a given cruise using age-length keys derived from the same cruise. Length frequencies for 1984, 1985, and 1986 spring surveys were expanded using age-length keys from the previous year's fall survey on the assumption that minimal growth occured during the fall and winter spawning season. To test this assumption, the age-length keys for 1, 2 and 3 year olds were compared between the fall 1982 survey and the spring 1983 survey using an analysis of variance. No effect of season was found (P=.91), nor was mean length at age significantly different

between the fall and subsequent spring (Scheffe's test, $P>0.05$). In contrast, significant effects of year were found when fall age-length keys for 1983-1984, and 1985 were compared ($p<0.01$).

To standardize for annual variations in effort in the commercial fishery, commercial catch at age data for each year were divided by total effort (tonnage classes 2, 3 and 4 otter trawlers in which at least 5% of the catch was summer flounder) for that year. This provided an estimate of catch per unit effort at age which was used in the catch curve analysis.

In general, estimates of total mortality based on commercial and survey data corresponded well (Table III.1.13). Mortality has been highest on the 1975, 1979 and 1980 year classes. The estimate of Z for 1976 based on survey data (Z=.375) appears unreliable, as the coefficient of determination was low relative to the other years ($r^2 = 0.58$).

Yield Per Recruit

Calculations of yield per recruit were made using the Thompson-Bell method for each sex. Mean weight- at-age was estimated using the growth rate information described above. Estimates of spawning biomass per recruit for females were made using maturity estimates of Morse (1983). For all calculations, it was assummed that age two fish are fully recruited to the fishery and that 25% of age 1 fish are recruited. Yield per recruit was maximized at F=0.44 for male summer flounder ($F_{0.1} = 0.26$) and F=0.26 for females ($F_{0.1} = 0.16$). Plots of yield-per-recruit as a function of fishing mortality are provided in Figure III.1.3 for males and Figure III.1.4 for females. Spawning biomass per recruit declined markedly with increasing fishing mortality for females (Figure III.1.5).

Estimates of Fmax for males and females presented here are generally consistent with the ranges specified in the Source Document in a sensitivity analysis for summer flounder based on a more restricted set of growth data.

Discussion

A basic assumption for the summer flounder assessment is that a unit stock exists north of Cape Hatteras. This point is currently being addressed in part by ASMFC sponsored tagging studies which may help resolve some difficulties regarding this assumption.

Discussion of the summer flounder catches brought out a few points. It was felt that a summary of the commercial catches by number and weight would be useful in comparisons with the recreational data. There was also a discussion on what made up the catch portion in the recreational CPUE indices. Many felt that it was not appropriate to use only the "A" and "B1" fish since total catch includes the "B2" fish as well. Since all three types of fish make up the actual catch in any given year, we need to clearly indicate what it is we want from a catch/effort measure. It was noted that differences in minimum legal sizes among the states made the definition of the fully recruited stock
complex.

It was also suggested that looking at the catch of one year old animals per trawl haul north and south of Delaware Bay would be useful in exploring the variability of year class strength.

In discussing mortality, the group felt that natural mortality is probably relatively insignificant compared to fishing mortality. It was indicated that assuming an M value of 0.2, fishing mortality would be around 0.65 or 0.7. A question was raised as to whether M should be higher for males than females since their life span appears to be shorter, but it was pointed out that the catches are predominantly age four and younger, so this is probably not an issue.

Preliminary estimates of recreational length frequencies were presented and were very similar to those from commercial catches. This is somewhat surprising and suggests that combining the commercial and recreational survey data may be easier than anticipated. It was noted that the NMFS recreational survey does not include collecting scales for age determinations, precludes the development of an appropriate age length key. In the absence of data directly from the recreational fishery, it may be possible to use the age length key from the commercial catches. If so, this would allow development of catch at age data for an analytical assessment of summer flounder. Sampling by some states have included this information for the recreational fishery and may provide some needed information. However, ages for samples from New York and perhaps from North Carolina have not been determined, and may not be available soon.

It was noted that both commercial and recreational data are available for only seven years and that convergence of the VPA would require at least three years. The utility of pursuing a VPA with so few years of data was discussed.

The problem of the catch data used in the assessment and the total catches for summer flounder from the official US statistics not being the same was brought out. The difference was initially thought to be due to the assessment information being based on the data from Cape Hatteras north, corresponding to the defined unit stock, while the official US statistics include that portion of North Carolina south of Cape Hatteras. The group felt, how- ever, that the differences were too large for this explanation. A working group (WG-10) made up of Anne Richards, Tom Hoff, Mike Fogarty and Darryl Christensen was established to examine this discrepancy and report back at their earliest opportunity (Section V.6).

While differences in growth rates for males and females are apparent, the possibility of basing yield per recruit calculations on the data from both sexes combined was discussed. This procedure is routinely used in assessments of flatfishes in the North Sea. It was noted that the total mortality estimates were done using combined sexes.

It was noted that there were inadequate age-length samples from the "peewee" market category in 1983 to assign ages. However, it was suggested that this category is relatively stable and that an age could be assumed.

Information on the mortality of summer flounder discarded from the trawl fishery is needed to evaluate the trade-offs between size limits and mesh regulations. Fishery discards are difficult of to monitor accurately. The

amount of fishery discards in relation to landings is influenced by a variety of factors including: net mesh size, season, area fished, the age or size structure of the population, and the particular regulatory scheme in place. Factors significantly influencing the survival of discarded fish include: degree of net damage, duration of trawl tow, time on deck, handling stress, temperature and fish size (Murawski 1985). Another factor thought to be important is water depth. Since the average tow time in the summer flounder fishery in 1985 was 1.9 hours (T. Hoff, pers. comm.) the group expressed a concern that discard mortality may be high. Additional information should be evaluated, and it was noted that additional studies on flounders are ongoing.

Several states indicated that data collection programs are ongoing which should be useful in continued efforts to assess this stock. These data include young of the year indices from Maryland, Virginia and Delaware, new tagging programs in Virginia and North Carolina, a new study relating environmental factors to recruitment in Virginia and age length data from the recreational fishery in New York. All this information needs to be made available to the assessment process we are now undertaking.

III. SPECIES REVIEW -- Summer flounder

Table III.1.1 U.S.A. commercial summer flounder landings (MT) in NAFO[1] (Northwest Atlantic Fisheries Organization) Subareas 5 and 6 and total landings by USSR and foreign vessels 1963-1985.

Year	5Y	5Z	5ZE	5Zw	5NK	Subarea 5 Total	6A	6B	6C	6NK	Area 6 Total	Total USA	USSR	Other Countries
1963	5	1009	--	--	0	1014	--	--	--	3858	3858	4872	0	0
1964	2	620	--	--	0	622	--	--	--	3768	3768	4390	0	0
1965	0	621	--	--	0	621	--	--	--	4386	4386	5007	22	0
1966	38	286	--	--	0	324	--	--	--	4237	4237	4561	31	0
1967	36	453	--	--	0	489	--	--	--	3401	3401	3890	72	0
1968	34	--	40	141		215	31	4	0	2668	2703	2918	35	0
1969	18	--	23	81	0	122	22	0	0	1525	1547	1669	294	0
1970	21	--	10	105	0	136	23	0	0	2448	2471	2607	36	0
1971	12	--	28	122	0	162	52	0	0	2256	2308	2470	904	0
1972	10	--	9	162	0	181	50	0	0	3057	3107	3288	393	0
1973	0	--	40	334	0	374	61	3	0	3922	3986	4360	22	0
1974	22	--	285	1381	0	1688	2155	1737	724	747	5363	7051	0	0
1975	17	--	279	1718	57	2071	2474	2629	449	0	5552	7623	0	26
1976	23	--	648	3054	57	3782	3423	3073	479	0	6975	10757	0	9
1977	25	--	816	1117	82	2040	2600	3577	667	0	6844	8884	0	52
1978	7	--	710	1231	79	2027	1889	3534	1004	0	6427	8454	0	12
1979	5	--	793	904	94	1796	1719	5566	5451	0	12736	14532	0	11
1980	4	--	305	403	7	719	1514	4478	4825	0	10817	11536	0	57
1981	18	--	592	939	7	1556	1800	2160	2443	0	6403	7959	0	41
1982	212	--	819	1624	12	2667	1794	3346	2338	0	7478	10145	0	5
1983	61	--	1113	1935	11	3120	1636	3923	3143	0	8702	11822	0	0
1984*	17	--	1155	1379	12	2563	2250	4261	5124	0	11635	14198	0	
1985*	79	--	1409	2666	8	4162	2616	2956	2124	0	7696	11858	0	

[1] Formerly ICNAF (International Commission for Northwest Atlantic Fisheries).

* Preliminary data.

Table III.1.2 Reported US commercial landings of summer flounder, 1964-1985, by state (metric tons). Source: Fishery Statistics of the U.S., preliminary data.

	Reported U.S. Commercial Landings (MT)									
Year	MA	RI	CT	NY	NJ	DE	MD	VA	NC	TOTAL
1964	629	308	61	843	1669	7	254	678	936	5385
1965	199	227	48	1114	1645	11	334	899	1813	6290
1966	120	207	41	1121	1741	6	286	1065	1620	6207
1967	203	321	22	893	1380	0	200	864	1755	5638
1968	74	175	16	553	972	0	159	984	864	3797
1969	35	121	10	261	580	0	92	685	950	2734
1970	19	118	10	409	890	0	169	975	1192	3782
1971	40	125	15	495	841	0	135	776	1659	4086
1972	42	125	3	500	842	0	126	844	1750	4232
1973	230	291	24	830	1405	*	225	1469	2928	7402
1974	768	1160	12	1130	1590	0	322	1414	4627	11023
1975	804	1406	18	1470	1960	2	406	1554	4431	12051
1976	1841	3087	36	1456	2567	1	317	1501	4238	15044
1977	672	1845	29	976	2985	2	331	2064	4742	13646
1978	596	1456	73	885	2461	*	307	2700	4955	13433
1979	559	1285	14	648	2854	*	777	4554	7436	18127
1980	147	579	14	565	2179	*	601	3851	7658	15594
1981	254	1449	8	900	1824	3	182	1647	4434	10701
1982	674	2348	23	846	1994	4	157	1925	3828	11799
1983	1063	2078	70	651	2189	*	425	3690	4451	14617
1984	672	2032	60	1041	2886	4	368	4388	6579	18030
1985	1017	3416	45	1142	2555	5	216	2282	4973	15651

* Preliminary data.
*) Less than 500 pounds.

Table III.1.3 Number of summer flounder (thousands) caught by recreational fishermen in the Middle Atlantic and North Atlantic regions combined and type B2 catch as a proportion of the total landed (A+B1). For further explanation see Table III.1.4.

	North Atlantic and Middle Atlantic				
Year	Type A	Type B1	Type B2	Types A + B1	B2/A + B1
1979	15281	4515	2714	19,796	.137
1980	15849	5818	6197	21,667	.286
1981	4943	3671	4085	8,614	.474
1982	6730	7422	6424	14,152	.454
1983	18893	6485	13319	25,378	.525
1984	20355	3896	16672	24,251	.688
1985	7784	5441	2546	13,225	.193

Table III.1.4 Number of summer flounder (thousands) caught by recreational fishermen in the Middle Atlantic and North Atlantic Regions during 1979 - 1985. Catch Type A was available for identification. Catch Type B was not available for identification; Type B1 was utilized (e.g. filets, bait) or released dead, Type B2 was released alive. SE is standard error, CV is coefficient of variation. Source: USDOC Marine Recreational Fishery Statistics Surveys Atlantic and Gulf Coasts.

North Atlantic

Year	Type A No. ± 2SE	CV	Type B1 No. ± 2SE	CV	Type B2 No. ± 2SE	CV
1979	428 ± 228	27	134 ± 72	27	135 ± 110	41
1980	737 ± 478	32	227 ± 148	33	101 ± 52	26
1981	155 ± 108	35	81 ± 64	39	82 ± 58	36
1982	475 ± 108	23	1296 ± 584	22	169 ± 120	36
1983	1215 ± 644	27	362 ± 290	40	182 ± 144	40
1984	445 ± 212	24	346 ± 198	29	520 ± 321	31
1985	216 ± 142	33	281 ± 376	67	38 ± 36	49

Middle Atlantic

Year	Type A No. ± 2SE	CV	Type B1 No. ± 2SE	CV	Type B2 No. ± 2SE	CV
1979	14853 ± 12242	41	4381 ± 1266	14	2579 ± 658	13
1980	15112 ± 1574	5	5591 ± 1074	10	6096 ± 930	8
1981	4788 ± 1266	13	3590 ± 1520	21	4003 ± 1802	23
1982	6255 ± 1554	12	6126 ± 9614	78	6255 ± 12908	103
1983	17678 ± 5544	16	6123 ± 2430	20	13137 ± 6890	26
1984	19910 ± 7456	19	3550 ± 1362	19	16152 ± 2659	16
1985	7568 ± 3036	20	5160 ± 3466	34	2508 ± 1116	22

Table III.1.5 Recreational fishery catch (Types A + B1 + B2 in numbers) per unit of effort for summer flounder in the Middle Atlantic and North Atlantic. Effort is directed summer flounder trips.

Year	Mid-Atlantic	North Atlantic	Total
1979	7.69	2.92	7.32
1980	8.40	7.20	8.35
1981	3.66	2.89	3.64
1982	4.17	8.82	4.39
1983	11.04	6.51	8.17
1984	9.63	7.04	9.52
1985	8.15	2.45	7.56

Table III.1.6 Estimated recreational landings of summer flounder, corresponding U.S. commercial catch, total catch (commercial and recreational) and percentage of total comprised of recreational catch. Recreational catch estimates are based on national recreational fishing surveys conducted in the Mid-Atlantic and North Atlantic and include all harvested fish (types "A" and "B1").

Survey Year	Recreational Catch (mt)	Commercial Catch (mt)	Total Catch (mt)	Percent Recreational
1979	9,261	14,532	23,793	38.9
1980	12,197	11,536	23,733	51.3
1981	4,977	7,959	12,936	38.5
1982	8,010	10,145	18,155	44.1
1983	15,877	11,822	27,699	57.3
1984	12,531	14,198	26,729	46.9
1985	7,081	11,858	18,939	37.4

Table III.1.7 Stratifed mean weight (kg) per tow (delta distribution estimates) in NEFC spring and autumn bottom trawl surveys from Georges Bank to Cape Hatteras. C.V. is coefficient of variation.

Year	Mean	Standard Deviation	C.V.
		Spring	
1968	0.10	0.04	37.8
1969	0.10	0.04	38.2
1970	0.06	0.03	44.2
1971	0.18	0.06	35.3
1972	0.14	0.04	26.7
1973	0.33	0.06	19.0
1974	0.85	0.21	24.6
1975	1.05	0.27	25.9
1976	1.25	0.39	31.0
1977	1.21	0.22	18.2
1978	1.08	0.21	19.7
1979	0.22	0.06	25.8
1980	0.54	0.08	14.7
1981	0.60	0.11	17.4
1982	0.81	0.13	16.4
1983	0.43	0.08	17.6
1984	0.26	0.06	24.0
1985	0.82	0.15	18.5
1986	0.56	0.09	16.1
		Autumn	
1963	0.27	0.10	36.1
1964	0.46	0.22	48.1
1965	0.03	0.02	74.1
1966	0.01	0.01	96.8
1967	0.65	0.20	31.0
1968	0.51	0.14	28.1
1969	0.31	0.10	31.8
1970	0.07	0.04	58.4
1971	0.14	0.04	32.9
1972	0.13	0.03	25.4
1973	0.32	0.12	37.4
1974	0.97	0.21	21.4
1975	1.39	0.24	17.6
1976	0.49	0.09	17.7
1977	1.04	0.28	26.8
1978	0.26	0.06	24.2
1979	0.54	0.15	27.1
1980	0.40	0.11	28.4
1981	0.37	0.11	31.5
1982	0.46	0.13	28.9
1983	0.27	0.07	24.6
1984	0.41	0.14	33.9
1985	0.47	0.12	25.8

Table III.1.8 Stratified mean number per tow (delta distribution estimates) of summer flounder in NEFC spring and autum bottom trawl surveys from Georges Bank to Cape Hatteras. D.C. is coefficient of variation.

Year	Mean	Standard Deviation	C.V.
	Spring		
1968	0.10	0.04	37.8
1969	0.12	0.04	34.0
1970	0.06	0.02	35.0
1971	0.14	0.04	28.1
1972	0.30	0.08	27.1
1973	0.49	0.09	19.4
1974	0.94	0.23	24.5
1975	1.26	0.40	31.6
1976	1.77	0.50	28.5
1977	1.85	0.29	15.7
1978	1.79	0.36	19.9
1979	0.26	0.06	22.8
1980	0.86	0.15	17.2
1981	1.01	0.15	14.7
1982	1.50	0.26	17.5
1983	0.68	0.10	14.3
1984	0.44	0.13	28.3
1985	1.56	0.35	22.3
1986	1.40	0.22	15.7
	Autumn		
1963	0.29	0.10	34.9
1964	0.21	0.09	43.8
1965	0.03	0.02	74.0
1966	0.01	0.01	96.8
1967	0.70	0.21	30.0
1968	0.56	0.15	27.1
1969	0.30	0.10	31.6
1970	0.08	0.04	47.6
1971	0.21	0.06	30.8
1972	0.20	0.05	23.1
1973	0.43	0.10	23.3
1974	0.85	0.17	20.1
1975	1.58	0.26	16.4
1976	0.61	0.11	18.1
1977	1.26	0.36	28.4
1978	0.20	0.05	22.8
1979	0.64	0.24	38.2
1980	0.51	0.13	25.7
1981	0.46	0.14	30.1
1982	0.80	0.31	38.8
1983	0.48	0.18	38.1
1984	0.53	0.27	51.3
1985	0.64	0.17	26.4

Table III.1.9 Summer flounder commercial catch per unit effort (MT) for tonnage classes 2, 3 and 4 vessels for trips in which summer flounder comprised greater than 5% of the catch.

	Commercial CPUE (MT)		
Year	TC2[1]	TC3[2]	TC4[3]
67	0.67	0.72	0.45
68	0.78	0.78	0.46
69	0.59	0.87	0.62
70	0.44	0.73	0.73
71	0.57	0.77	0.57
72	0.60	0.57	0.60
73	0.79	0.63	0.10
74	1.20	1.01	1.08
75	0.81	0.84	1.06
76	0.98	1.30	1.64
77	0.81	1.39	1.48
78	0.95	1.56	3.14
79	0.85	1.82	2.80
80	0.86	1.99	2.84
81	0.74	1.60	2.48
82	0.82	1.72	3.35
83	0.96	1.59	2.39
84	0.94	1.54	2.06
85	0.65	1.11	1.54

1 5 - 50 gross tons
2 51 - 150 gross tons
3 151 - 500 gross tons

Table III.1.10 Catch per tow at age (numbers) of summer flounder from NMFS spring offshore surveys, Georges Bank to Cape Hatteras. The smoothed survey index was used. Discrepancies between the totals and the overall survey index are due to rounding errors.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	Total	Survey Index
1976	0	.1867	.9172	.3472	.1163	.0622	.0082					1.6378	1.6379
1977	0	.3485	.7921	.4182	.0612	.0510	.0085		.0051			1.6846	1.6998
1978	0	.3470	.4617	.3375	.1593	.0230	.0108	.0108			.0027	1.3528	1.3501
1979	0	.0673	.2019	.0874	.0446	.0157				.0166		.4335	.4371
1980	.0046	.4238	.1821	.0899	.0139	.0271	.0170					.7584	.7747
1981	.0288	.3607	.3458	.1222	.0666	.0318	.0129	.0199	.006			.9947	.9937
1982	.0036	.2431	.5020	.3314	.0835	.0157	.0169	.0048				1.2010	1.2098
1983	0	.1991	.1768	.2682	.0468	.0223	.0097	.0223				.7462	.7435
1984	.0143	.1486	.2847	.0776	.0298	.0275	.0275		.0054			.6154	.5968
1985		.0618	.7242	.3848	.0921	.0088		.0025				1.2742	1.2616
1986		.6992	.4439	.1652	.0396	.0205						1.3384	1.3657

Table III.1.11 Commercial catch at age in numbers (hundreds). Figures do not include summer flounder in the "unclassified" market category.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13
1976	0	4,280	28,370	9,837	8,175	1,134	130	6						
1977		452	11,909	11,257	1,597	1,031	190	25	31					
1978	52	1,409	10,028	22,706	8,038	1,636	1,400	106	23					
1979	74	4,857	20,272	14,921	7,251	2,945	681	204	178	55	9	20		
1980		6,280	19,669	9,205	2,792	1,425	541	105	13					
1981	931	13,620	32,243	13,692	2,866	2,510	903	395	46	221	133			
1982	1,970	19,639	63,287	24,408	4,665	1,549	452	334	203	112	26	34	10	8
1983*	1,123	14,513	78,330	39,407	11,928	5,382	2,302	581	146	348	220			

*Does not include market category 5 ("pee-wee's").

Table III.1.12 Parameters of the von Bertalanffy growth equation derived for summer flounder from north of Cape Hatteras to Georges Bank. Asymptotic standard errors for each parameter are provided in parentheses.

Parameter	Male	Female
L	67.49 (9.26)	82.67 (8.68)
K	0.183 (0.068)	0.1731 (0.056)
t_0	-1.657 (0.649)	-1.039 (0.691)

Table III.1.13 Estimates of summer flounder instantaneous rate of total mortality (Z). Estimates are based on catch curve analysis of commercial age-length data adjusted for total effort and on NEFC survey data. Males and females are combined. Std (Z) is the standard error of the estimate of Z, r^2 is the coefficient of determination.

	Survey			Commercial		
Year Class	Z	Std (Z)	r^2	Z	Std (Z)	r^2
73	-	-	-	.687	.116	.85
74	.833	.275	.75	.838	.093	.94
75	.975	.141	.94	1.090	.070	.98
76	.375	.161	.58	.986	.186	.90
77	.782	.089	.96	.700	.174	.89
78	.889	.212	.85	.850	.336	.86
79	.955	.249	.88	-	-	-
80	1.708	.282	.97	-	-	-
81	.629	.217	.81	-	-	-

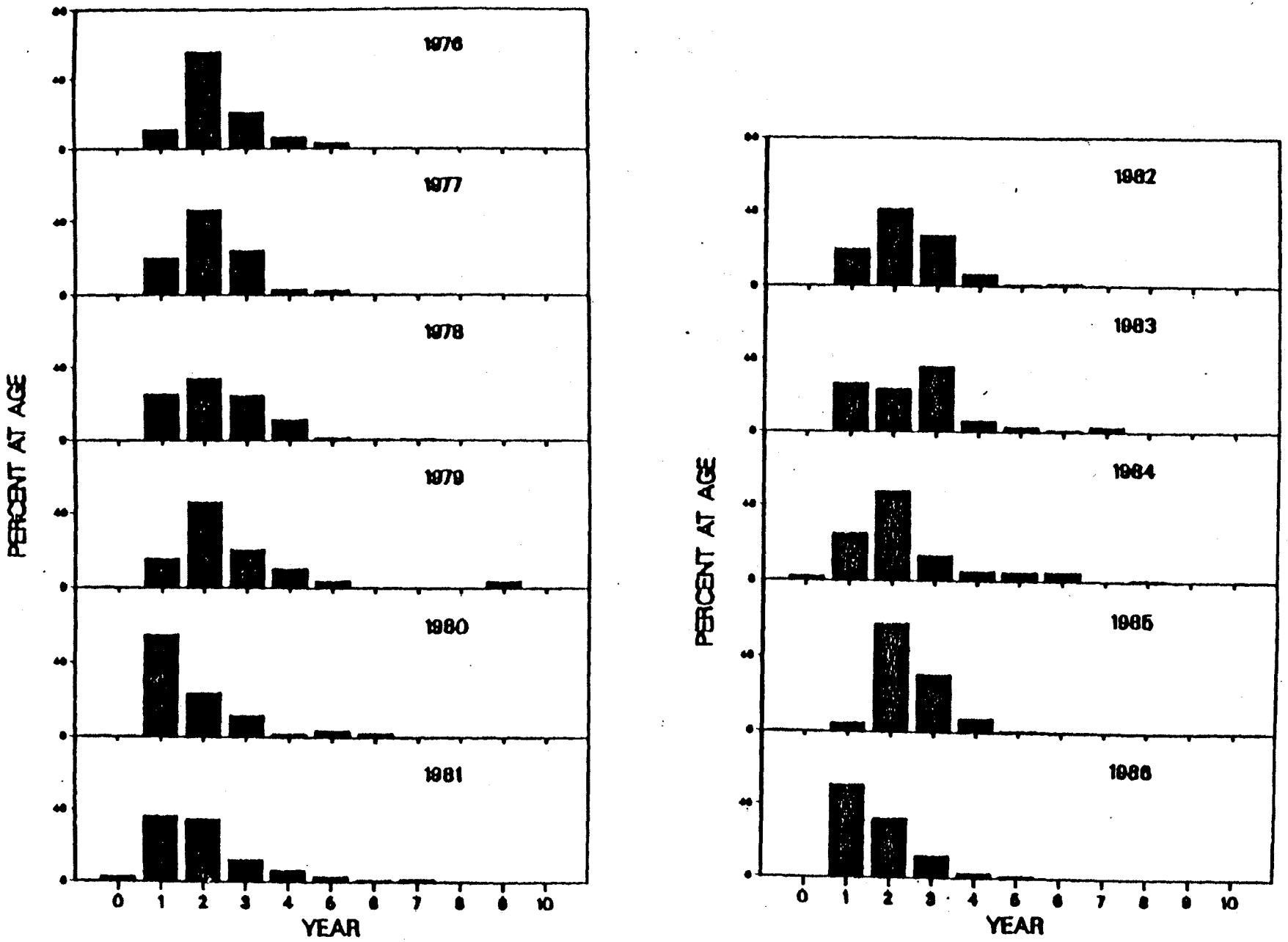


Figure III.1.1 Mean number per tow at age, (expressed as percent of total) for spring offshore surveys, 1976 - 1986.

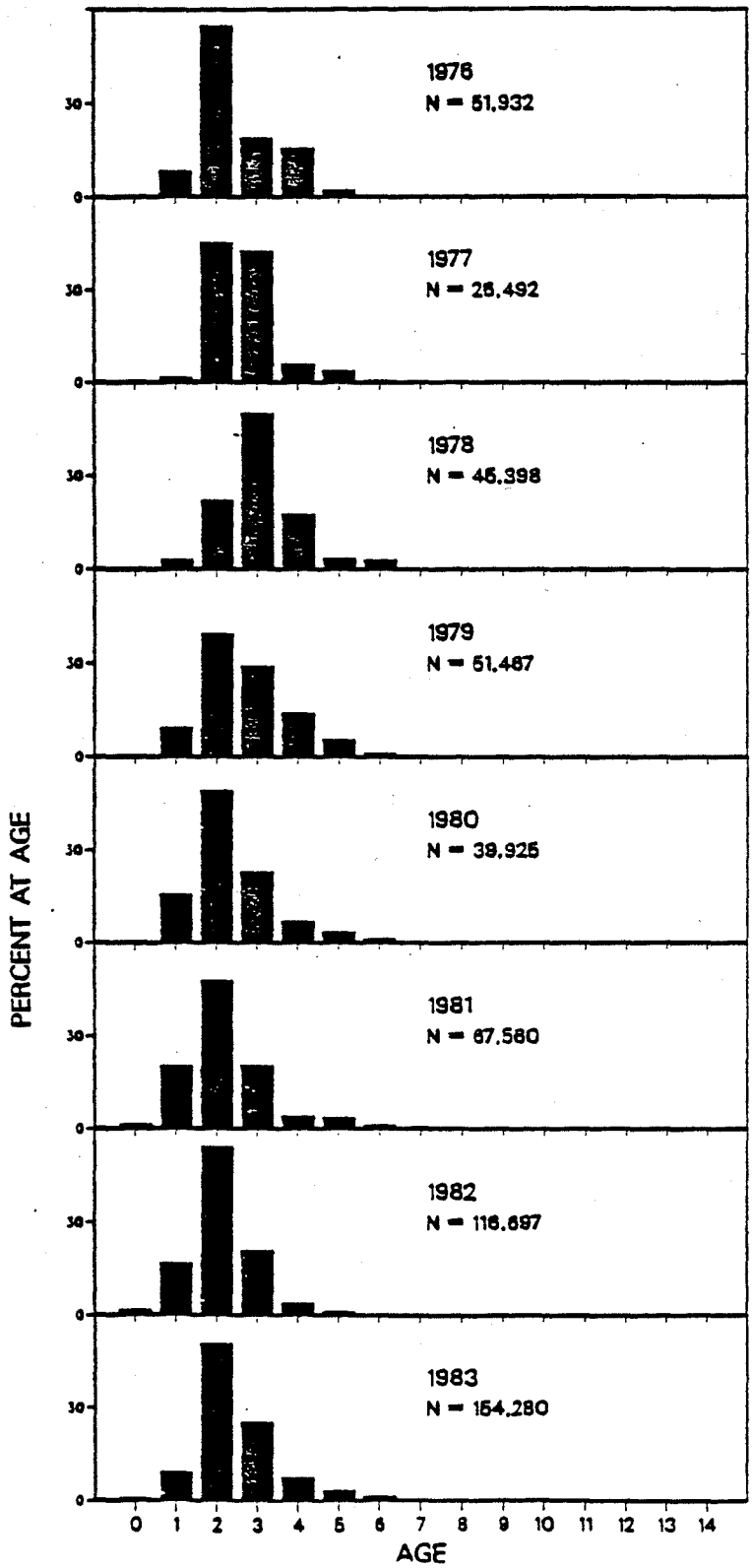


Figure III.1.2 Percent age composition of commercial summer flounder landings, 1976 - 1983. N is given in hundreds of fish.

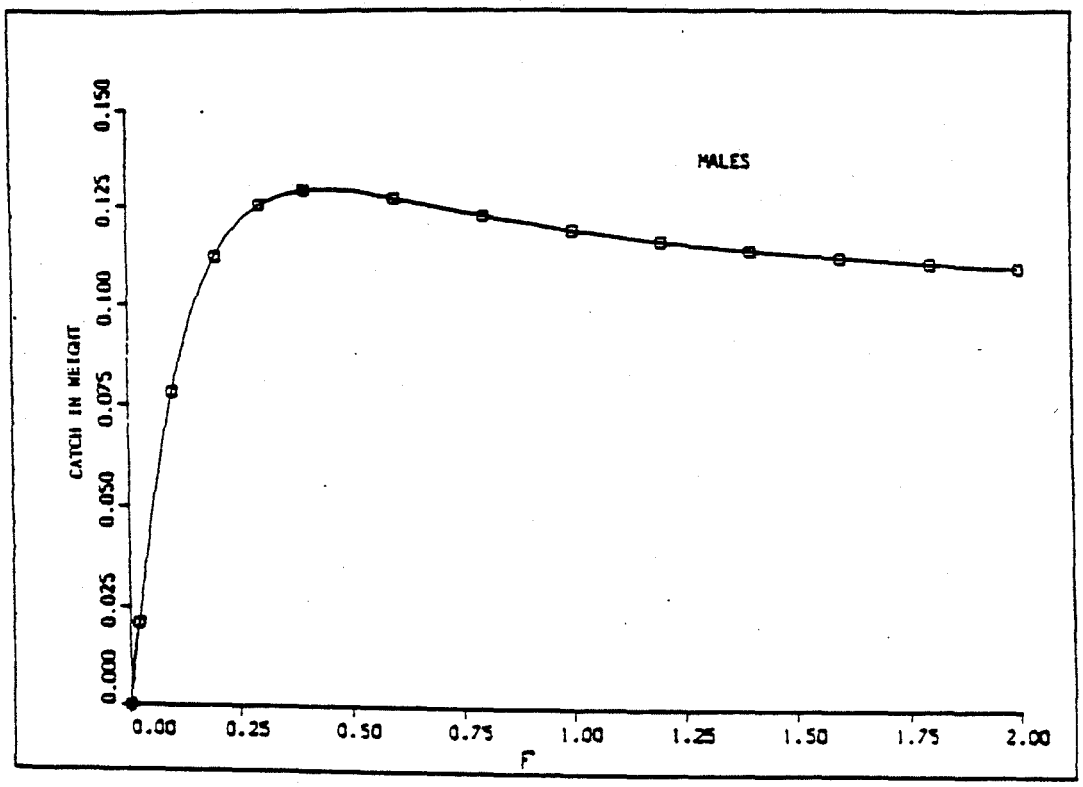


Figure III.1.3 Yield per recruit as a function of F for summer flounder males.

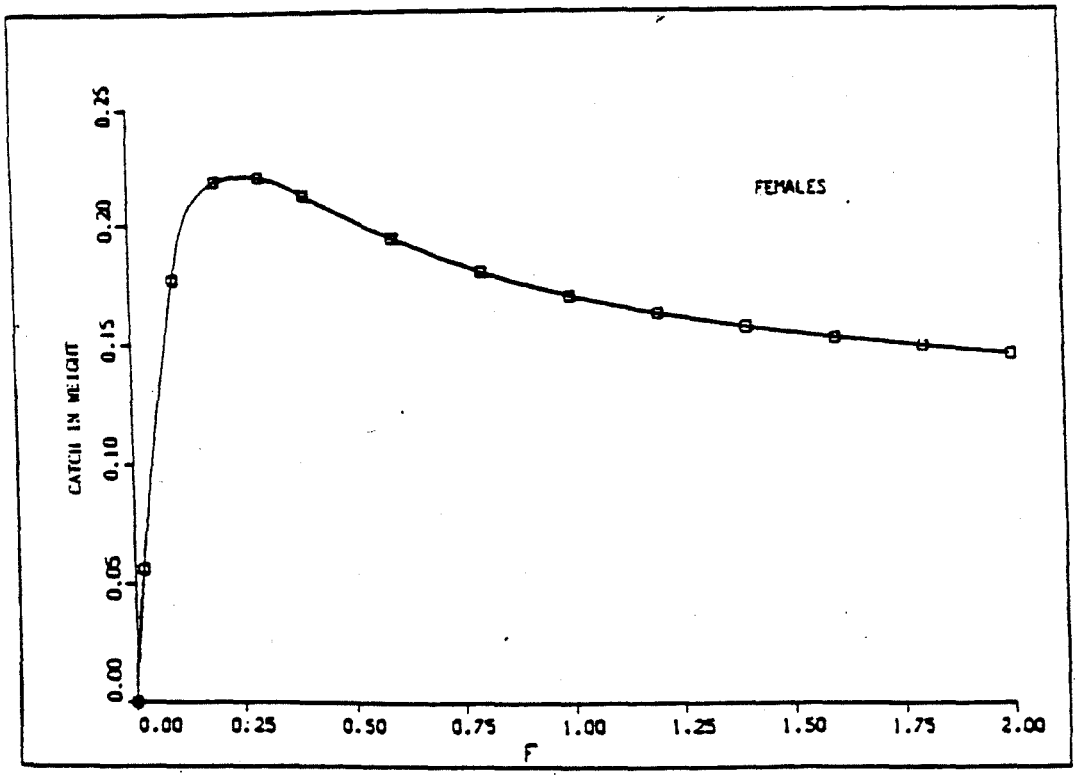


Figure III.1.4 Yield per recruit as a function of F for summer flounder females.

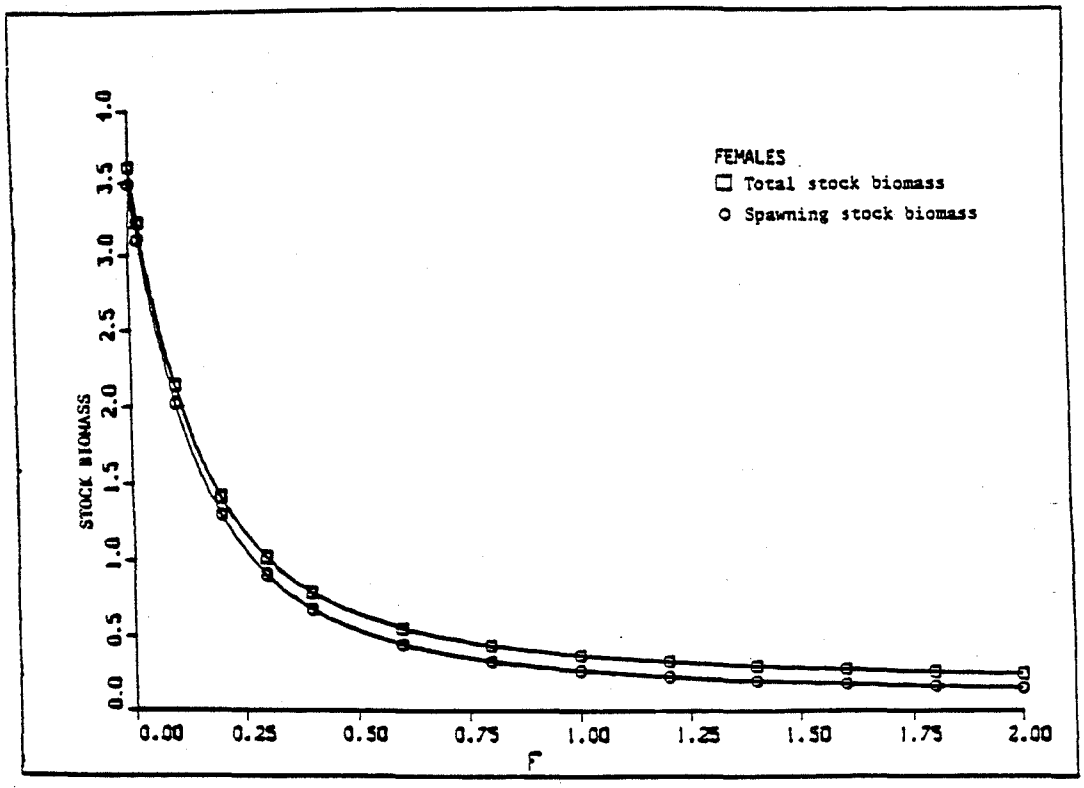


Figure III.1.5 Spawning stock biomass per recruit as a function of F for summer flounder females.

2.1 OFFSHORE AMERICAN LOBSTER

Source Document: Fogarty, Michael J. and J.S Idoine. 1986. Population Assessment of the American Lobster on the Outer Continental Shelf. NMFS, NEFC, Woods Hole Lab Ref. Doc. No. IN REVIEW.

Summary

A population assessment of the offshore American lobster fishery is provided which describes trends in landings, relative abundance measured by catch-per-unit effort and research vessel surveys, growth, and yield and egg production per recruit. Both landings and relative abundance levels declined for two decades but have stabilized in recent years. Average landings during 1980-83 declined 46% from peak landings of approximately 4,000 mt in 1972. Landings in 1984 rose to approximately 4,200 mt. Research vessel indices for the Nova Scotia-Middle Atlantic area declined 54% during 1980-84 relative to the peak 1964 level. Considerable regional variation in abundance levels was noted.

Growth rates of offshore lobsters by sex were determined from tagging studies conducted on the outer continental shelf during 1969-71 (see Cooper and Uzmann 1971; Uzmann et al. 1977). An empirical growth model was constructed based on the estimated size specific probability of annual molting and the incremental increase in carapace length per molt. Wide variability in growth rates due to the discrete growth patterns and variability in molt increment was explicitly considered in the model.

The growth model served as a primary input into a yield and egg production-per-recruit model. A simulation model was constructed which explicitly accounted for the discontinuous crustacean growth pattern, variability in molt increment, molt-related mortality and size specific harvesting. The sexes were treated separately due to differences in growth rates and the fact that fishery regulations differ by sex; egg-bearing females cannot be legally harvested. The yield model was essentially a double numerical integration over size (1 mm increments) and time (1-year intervals). Increases in yield and egg production per recruit would be realized by any increases in minimum legal size limits. Assuming a fishing mortality rate of F=1.0 in the offshore fishery, yield per recruit would be increased by approximately 7% for both males and females if the minimum legal size limits were raised to 85 mm carapace length (CL). Yield per recruit would be increased by 16% for males and by 14% for females with an increase in the minimum legal size to 89 mm CL at F=1.0. An increase in egg production per recruit of 30% would result if an increase in minimum legal size limits to 85 mm CL were implemented and 72% if a 89 mm CL minimum legal size limit were enforced with F=1.0. Reductions in fishing mortality also offer a viable approach to increasing yield and egg production per recruit. A decrease in fishing mortality from F=1.0 to F=0.5 would result in a 30% increase in yield per recruit for males and a 21% increase for females at the current minimum legal size. An increase in egg production of 251% is predicted by reducing fishing mortality from F=1.0 to 0.5 at the existing minimum legal size.

Discussion: It was observed that the use of numbers vs. weight per unit of effort in estimating abundance may underestimate recent increases in abundance because larger lobsters are observed less frequently.

The performance of the growth model was considered. I was noted that hatchery observations of growth per molt support this representation. Interestingly, the relationship between growth/molt and molt frequency causes some lobsters to attain the same "length at age" but in very different ways (e.g., many molts of small increments vs. few molts of large increments). Likewise, a wide variation in length at age can also occur.

The influence of recruitment in the yield per recruit model was discussed. The cohort model uses 100 lobsters in 16 different length increments as the input, distributed over the length frequency from 65-80 mm C.L. (i.e., pre-recruits). It was observed that this method produces slight differences in yield/recruit compared to the more traditional (knife edge) recruitment models. However, the present model does conform to traditional approaches using t_c and "age" at recruitment (t_r), but controlled by length rather than age. The model is most sensitive to changes in minimum length at high fishing mortality rates.

Increases in minimum legal size were shown to have important effects on both YPR and on egg production per recruit. Decreases in fishing mortality (F) also would have beneficial effects on yield and egg production per recruit. This rationale for increasing MLS was discussed in reference to perceived management objectives.

It was noted that reducing F to increase yield per recruit is difficult to accomplish because of the relationship of fishing mortality to fishing effort. For instance, a greater proportional decrease in fishing effort is required to attain some level of decrease in fishing mortality (e.g. a 50% decrease in effort may be required to achieve a 40% decrease in F).

The phenomenon of gear saturation was discussed. It was felt that it was apparent in the inshore Maine fishery and likely was a factor to some lesser extent offshore.

The forecasting ability of the model, based on survey indices, was discussed and it was suggested that this be considered based on a prerecruit index.

The use of this (more complex) model was questioned since a more conventional one predicts yield per recruit about as effectively. The model provides a greater opportunity to look at a variety of options than do more conventional ones, by following the distribution of a cohort through the fishery (thru time). This enhances the predictive capability of the model.

2.2 INSHORE AMERICAN LOBSTER

Discussion of Research Needs: Historical data on US lobster catch and effort was presented, with the state of Maine representing the greatest portion (Table III.2.2.1). Total effort (number of traps) increased dramatically since the 1970's, along with a corresponding increase in catch. The recent incease in inshore landings has been primarily due to increases in the southern New England and Mid-Atlantic regions. Two production models were presented which illustrated the relationship between landings and nominal effort for the total fishery.

Catch per trap-haul-set-over-day (THSOD) for the Maine fishery from 1968-1985 has fluctuated between 0.07 and 0.13 kg per THSOD. A decrease in CPUE from 1968-1972 caused concern about a stock decline; however, the index subsequently returned to higher levels, and has been relatively stable overall. The mean carapace length of lobsters caught in the Maine fishery from 1965-1980 ranged from 86-90 mm remaining relatively stabile over time.

Size composition data from 1968-1984 for the Maine commercial catch served as a input to length based cohort analysis. The modal catch was in the 86-90 mm length group. Population estimates derived from the cohart analyses were stable.

Inshore mortality rates derived by length-based cohort analysis may be overestimated and abundance underestimated if the effects of migration of lobsters from inshore to offshore areas cannot be accounted for. Total annual mortality rates based on changes in CPUE from year to year range from 1.5 to 3.0 for the Maine fishery depending on the method of calculation used.

It was recommended that a group of state, federal, and univeristy biologists should apply the methods of length-based cohort analysis to data from their respective states' fisheries. In further discussions it was agreed that these investigations should apply more recently developed assessment techniques to data bases that have expanded in the last several years. It was suggested that this project be discussed at the ASMFC meeting in October.

Analyses of yield per recruit relative to fishing mortality and age at entry into the fishery were presented.

Time series modeling results showed that yield can be predicted based on temperature and catches in prior years. The predictions can be confidently made one year in advance for Maine data. It was questioned whether the model would work differently for data from southern New England states where the temperature regime is much different.

Representatives from the states described their ongoing research and assessment programs. Massachusetts conducts a commercial fishery sea sampling program involving monthly sampling at representative areas covering the state's waters. The need for more scrutiny of the relationship between inshore and offshore stocks off Massachusetts was emphasized. The resource in territorial waters is heavily exploited - 70% of the state's landings are taken there. The mechanism of recruitment of lobsters into the inshore

fishery needs to be better understood. This can be accomplished by including a more comprehensive assessment of all available inshore data in an annual resource assessment. In addition, studies of lobster habitat relative to resource abundance were identified as a research need.

In New York, the fishery on the south shore of Long Island is essentially dependent on the offshore population in that area. However, in Long Island Sound, the population has several unique characteristics - including negligible migration, and small size at maturity (at least one molt group below the minimum legal size). The need for further studies on fecundity in all areas to gain information on the effect that a possible future increase in the minimum legal size might have on the population was expressed.

In Connecticut, commercial pot fishery and research trawl sampling produces data on lobster abundance and size distribution. Sampling for larvae and juveniles has been conducted since 1983 to develop a time series of data from which predictions of legal size stock abundance may be made. Unique characteristics of Long Island Sound and its lobster population such as the retention of larvae, high larval abundance, and negligible migrations increase the probability of developing good predictive capability. A question about sampling larvae in sea surface fronts in which neuston organisms are concentrated was discussed. In Long Island Sound larvae are not significantly more abundant in fronts than in non-front water. Fronts appear to be of short-term duration there, probably not lasting through a tidal change.

Results of recent offshore tagging studies were presented. From 1983 - 1985 the total tag return rate was approximately 35%. Movements from the offshore tagging area (Crowell Basin and Jordan Basin) included: inshore to the Maine coast, southwest, southerly, to Georges Bank, to Nantucket Shoals, and to the offshore canyons. Movements as far as 198 nautical miles and as fast as 3.4 nautical miles per day were observed.

Observations by Rutgers University researchers in the Mid-Atlantic Bight included a behavioral preference of lobsters to occupy tilefish burrows. Concern for the impact on the offshore lobster population there by heavy fishing pressure on the tilefish population was expressed. Postlarval and small juvenile lobsters, often less than 10 mm carapace length, have been collected in marsh areas of Nauset Harbor, Massachusetts, using a diver-operated suction sampler. Significant numbers of fourth stage larvae (60 per hour) have been collected while nightlight sampling for larval fishes in southern New Jersey waters. The significance of studies on early life history stages, about which little information is available, was emphasized.

Further discussion on tagging studies involved the problem of loss of information due to the high exploitation rate, especially inshore, where most tagged lobsters are caught before they are at large for a full season. Future tagging studies should try to assure that tagged lobsters will be at large longer to obtain more extensive information on migrations. The need for contact and cooperation with the fishermen to return tagged lobsters to the water was expressed. A need for additional tagging studies, particularly in the Wilkinson Basin and Jeffreys Ledge areas, was identified to further delineate inshore/offshore relationships in the Massachusetts region.

Questions were directed to the issue of v-notched lobsters from Maine caught in Massachusetts waters. V-notched lobsters are taken in the more northern areas - Cape Ann and eastern Cape Cod regions where the percent of legal-sized females that are v-notched ranged from 3-6% in 1984-1985 commercial pot samples. In Chatham, 13% of the females bearing green eggs collected during autumn tagging efforts (1984-1985) were v-notched.

Table III.2.2.1 American lobster landings (mt) by state 1928-1985.

Year	ME	NH	MASS	CONN	RI	NY	NJ
1928	3221	59	926	315	743	-	-
1929	3003	57	740	269	614	285	337
1930	3509	82	1061	333	614	243	457
1931	3240	65	1019	226	571	215	295
1932	2743	100	974	272	570	180	213
1933	2675	98	874	153	321	157	163
1934	2439	-	-	-	-	-	-
1935	3487	88	819	248	281	191	99
1936	2323	-	-	-	-	-	-
1937	3333	71	966	237	351	166	122
1938	3474	77	1050	251	322	111	148
1939	3005	81	1057	267	288	106	196
1940	3667	107	1106	216	169	87	182
1941	4054	-	-	-	-	-	-
1942	3812	132	1022	186	196	59	150
1943	5202	518	1143	104	132	82	230
1944	6376	311	1243	127	106	73	222
1945	8677	374	1301	132	121	54	131
1946	8517	-	1489	181	163	126	143
1947	8290	236	1665	204	178	178	50
1948	7223	182	1457	133	174	88	136
1949	8742	189	1615	171	161	125	126
1950	8324	278	1412	100	113	52	115
1951	9415	232	1686	141	96	58	43
1952	9087	186	1586	127	41	117	51
1953	10112	277	1712	105	55	166	50
1954	9818	352	1569	90	86	114	47
1955	10302	386	1589	102	201	94	76
1956	9316	347	1475	83	91	93	111
1957	11068	413	1500	83	116	78	55
1958	9665	372	1415	83	118	85	91
1959	10126	388	1569	107	185	122	89
1960	10889	424	1497	108	206	106	80
1961	9485	373	1294	94	176	115	84
1962	10013	329	1421	113	118	79	49
1963	10344	339	1382	114	76	65	20
1964	9713	386	1703	132	95	112	34
1965	6556	347	2869	337	816	294	462
1966	9034	366	2180	355	759	331	347
1967	7479	326	2121	409	885	398	399
1968	9300	342	2160	403	1394	530	549
1969	8997	332	2234	424	1926	641	651
1970	8243	312	2560	305	2357	747	833
1971	7964	307	2773	237	2444	812	600
1972	7374	306	3629	245	1524	519	593
1973	7731	225	2541	247	1258	405	618
1974	7465	226	2696	293	1420	332	502
1975	7719	218	2520	295	1635	303	370
1976	8619	216	3018	269	1440	269	292
1977	8381	215	3335	218	1573	241	362
1978	8678	213	4446	289	1264	264	420
1979	10040	284	4408	362	1029	308	365
1980	9970	328	689	374	1087	333	232
1981	10266	360	640	352	849	404	269
1982	10886	360	5080	406	862	509	383
1983	9968	599	5723	751	2303	548	349
1984	8863	711	5825	890	2374	593	421

3. WEAKFISH

Source Document: Boreman, John and Richard J. Seagraves. 1984. Status of Weakfish Along the Atlantic Coast, 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc.No. 84-19. 43 p.

Discussion of Weakfish Assessment Needs:

Weakfish are a valuable commercial and recreational sport fish found along the United States east coast. Historically, the landings of weakfish have fluctuated widely. The 1984 stock assessment on this species determined that present F's are greater than F_{max} from Maryland south. Most fisheries on weakfish begin to take fish at about age 1. The NMFS's assessment demonstrated that both yield and egg per recruit for this species would greatly increase by delaying the age of entry. Increases in yield would be increasingly beneficial until catch at age 4.

The Atlantic States Marine Fisheries Commission's (ASMFC) Sciaenid Technical Committee considered Boreman and Seagrave's assessment findings during development of its 1985 Interstate Fishery Management Plan for Weakfish. The assessment was based in part on NMFS's fall trawl survey data. Since otter trawls were not considered the best gear for sampling weakfish, the assessment data on abundance and sizes of weakfish were not accepted as truly representative of the east coast weakfish population. The assessment assumed a single stock of weakfish. However, differences in age at maturity, fecundity, and size at age occuring along the coastline suggest that there may be more than one stock. This factor, as well as lack of understanding of weakfish population dynamics and coastal migratory behavior, confounded attempts to agree upon possible spawner recruit relationships. ASMFC did not use the Boreman and Seagrave assessment as a factor in recommending management measures for weakfish for a variety of reasons. ASMFC's plan does call for some moderate protection of the stock by recommending that the northeast states institute size limits that protect age 1+ weakfish. The plan also calls for the promotion of the use of trawl efficiency devices (TEDS) in the South Atlantic shrimp fishery. These devices, if properly employed on shrimp nets, can considerably lessen by-catch mortalities of juvenile weakfish and other sciaenids. Establishing coordinated coast-wide research activities on the species remained a high priority of the ASMFC plan. Stock identification and coastal migration studies need to be carried out, with tagging of fish given a high priority. Nesbit's (1954) paper should be reviewed before tagging programs are begun because this is the only paper that has reported successful recaptures of weakfish. The use of mitocondrial DNA and scale optical pattern recognition methods, and parasite studies should be looked at as possible methods for stock identification. Interactions with other species and predator prey relationships should be studied. Attempts at correlating abundance of older fish with past recruitments of younger fish from separate areas should also be carried out.

The University of Delaware is instituting extensive studies on environmental effects on weakfish reproduction, growth, survival, food preferences of larval weakfish, and feeding, growth, and survival of juvenile weakfish. Virginia's Institute of Marine Science is starting a program on stock identification of weakfish which will be evaluating several different methods to differentiate between stocks. ASMFC's Interstate Fisheries Management Program, through its Sciaenid Technical Committee, will attempt to coordinate the numerous individual research activities on this species. NMFS, F&WLS, state, and university research biologists are expected to take part in the program. The Sciaenid Committee will prioritize research and design a long-term comprehensive research program for this species.

4. ESTUARINE WINTER FLOUNDER

Source Document: Foster, K. L. 1986. Status of Winter Flounder (*Pseudopleuronectes americanus*) stocks in the Gulf of Maine, Southern New England and Middle Atlantic Areas. NMFS, NEFC, Woods Hole Lab. Ref. Doc. IN REVIEW. 67 p.

Summary: USA commercial landings of winter flounder from the Gulf of Maine (excluding Georges Bank), Southern New England and Middle Atlantic areas have decreased steadily from a peak of 13,500 mt in 1981 to 8,000 mt in 1985. The 1985 total was 23% below the 1984 landings of 10,500 mt. Conversely, recreational catch estimates for the North and Middle Atlantic areas in 1985 (31,000 mt) were the highest in the time series of such estimates dating back to 1960. The 1985 recreational catch was more than triple the 1984 value (9,900 mt). Landings from these winter flounder stocks by Canada and DWF's (distant water fleets) have been negligible since the early 1970's.

Gulf of Maine Stock Area: Commercial landings of winter flounder declined 7% between 1984 (1,700 mt) and 1985 (1,600 mt). The 1985 landings were the lowest since 1976, (1,500 mt) and were 43% below the record 1982 catch of 2,800 mt. Likewise, commercial CPUE indices (catch per day fished of ton class 2 otter trawlers) decreased 6% between 1984 (0.34 mt/day) and 1985 (0.32 mt/day), to establish a record low value for the 1964-1985 time series. Commercial CPUE for Gulf of Maine winter flounder has decreased 40% since 1981 (0.53 mt/day). NEFC and Commonwealth of Massachusetts bottom trawl survey programs generally indicate substantial declines in recent years, after relatively high abundance indices in the early 1980's (coincident with the period of maximum landings). All data sources suggest a resource decline in recent years, as compared with historically high abundance in the late 1970's early 1980's.

Southern New England Area: Commercial landings of winter flounder in the southern New England area declined 27% from 1984 (8,800 mt) to 1985 (6,500 mt), continuing a four year trend in decreased landings. Since 1981 landings from the southern New England region have declined 42%. Likewise, CPUE (tons per day fished by ton class 3 vessels) has trended sharply downward from a peak of 1.28 mt/day in 1981 to 0.42 mt/day fished in 1985 (- 67%). NEFC and Commonwealth of Massachusetts bottom trawl survey indices generally confirm the decrease in resource abundance implied in the reduction in landings and CPUE. The autumn offshore abundance indices (numbers) for 1984 and 1985 were lowest, and fifth lowest, respectively, of the 23 year time-series of observations. The proportion of landed fish assigned to the two market categories having the largest fish (large, lemon sole) has declined steadily during the past two decades, geneally reflecting the increased fishing mortality rate on the stock.

Middle Atlantic Area: The Middle Atlantic area contributes the smallest proportion of landings of the three stock areas delineated for estuarine winter flounder. In 1985, the Mid-Atlantic region accounted for 1% (92 mt) of the region-wide (8,100 mt) total. Landings for this area peaked during the late 1970's, early 1980's (maximum was 556 mt in 1979), and have declined sharply since. NEFC offshore abundance indices are inconclusive, but inshore data confirm declines in resource abundance since the early 1980's. Stock abundance has likely declined since the early 1980's, however, the status of Mid-Atlantic winter flounder populations is more conjectural than for Southern New England and Gulf of Maine.

Discussion: Discussion of estuarine winter flounder populations considered aspects of the biology of the stocks, and analysis of available data on resource abundance. Stock structure is obviously a central question related to the population biology of the species. The extent of reliance of the offshore fishery in southern New England and the Mid-Atlantic waters, on fish spawned in Long Island Sound and Narragansett Bay was discussed at length. Results of NEFC ichthyoplankton surveys indicate little apparent offshore spawning in southern New England or the Middle Atlantic Bight (see Figure III.4.1, W. Morse, pers. comm.). These data thus support the contention that inshore stocks support the offshore fishery.

The utility of ageing structures for resolving stock composition of winter flounder was considered. An ongoing NEFC research project seeks to determine if scales or ototliths can be used to identify estuarine spawning locations. A workshop on ageing structures will be conducted during 3-4 December in Mystic, Connecticut, to discuss aspects of growth and population biology of winter flounder.

The Workshop participants discussed current studies being conducted by various state and federal agencies with respect to winter flounder biology as related to habitat degradation. Winter flounder are affected in many east coast estuaries by 'competing stresses' (i.e. habitat stress and degradation affects reproduction and natural mortaltity rates in the estuaries, while intensive fisheries remove a substantial portion of the available stock on an annual basis).

It was noted that since recreational survey data are not collected on a stock-area basis, it was not possible to accurately allocate sport catches to the stock from which they were derived. Proposals for including such data in the survey design are currently being discussed witn NMFS personnel responsible for the recreational fishery data collection scheme. Also noted was the sharp increase in reported recreational landings during 1985. Part of the apparent increase in landings may be due to a change in the intensitivity of sampling in certain areas in 1985. Analyses of these data are ongoing.

The lack of sufficient ageing data for the stocks (especially estuarine and nearshore) has generally precluded the use of traditional age-based assessment methods to analyze the condition of the stocks, and to compute biological reference points for management. Given the extensive length frequency data bases collected by the various states and NMFS, it was felt that length-based assessment methods could provide valuable results on the status of these resources.

Several exploratory analyses were undertaken by participants to attempt to compute surplus production curves for various stocks of winter flounder, from available data on catch, CPUE, and trends in total effort. Results were inconclusive due to the lack of complete data and the confounding aspects of mixed-species commercial effort and recreational fisheries. Nevertheless, such analyses were encouraged, particularly for stocks wherein analytical assessment data are not available.

The general conclusion of the Workshop was that the abundance of winter flounder in all stocks has declined and may be near historically low levels. This is supported by data from a variety of data sources collected by both federal and state (e.g. Massachusetts, Rhode Island, Connecticut) agencies. Closer coordination and integration of data bases and analyses was strongly recommended by the Workshop participants. The obvious focal points for coordinated analyses of winter flounder stock status are in the Living Marine Resources (LMR) working groups established in conjuntion with EPA/NOAA studies in several major East coast estuarine systems. Also, representatives from the states were encouraged to bring data and analyses of winter flounder stock status to future SAW meetings, and to thereby integrate these data into the overall evlauation.

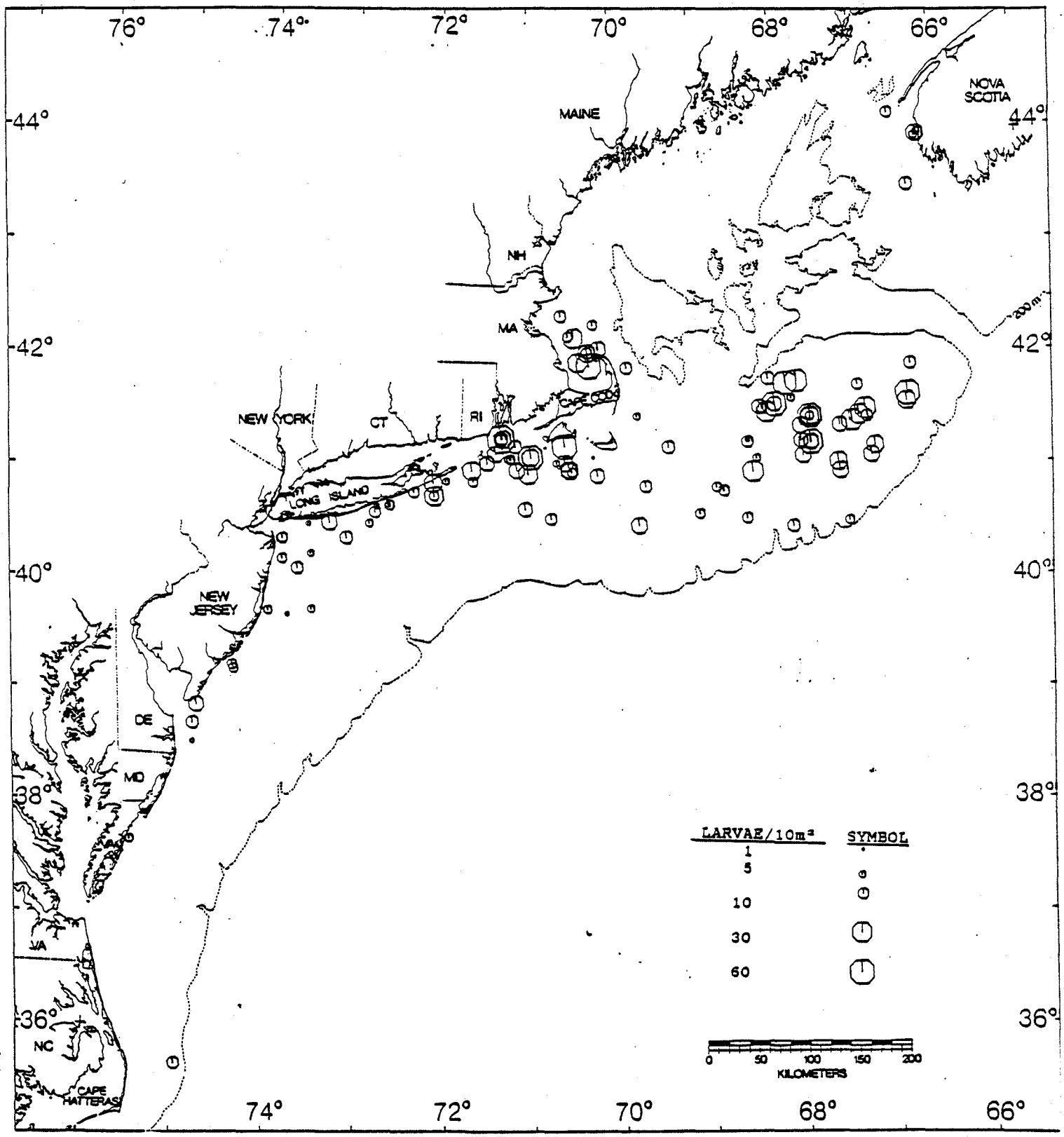


Figure III.4.1 A plot of all winter flounder larvae captured on MARMAP surveys during 1977 - 1984. Symbols represent the abundance of larvae per $10m^2$. The symbols vary in size according to abundance.

5. BLUEFISH

Source Document: Boreman, John. 1982. Status of Bluefish Along the Atlantic Coast, 1982. NMFS, NEFC, Woods Hole Lab. Reference Document No. 83-28. 67 p.

The Fishery

Recreational

Estimates of the bluefish catch along the Atlantic Coast from Maine to Florida are available from the Marine Recreational Fishery Statistical Survey (MRFSS) for the years 1979 through 1985. Recreational catch peaked at about 67.7 thousand mt in 1980. The 1984 estimate was 40.1 thousand mt; 1985 catch was about 49.9 thousand mt (Table III.5.1). The recreational fishery accounts for about 90% of total bluefish catch. Greater than 75% of this catch occurs within 3 nautical miles of the coast. The importance of bluefish to the marine recreational fishery has increased fourfold in the North Atlantic (Maine to New York/New Jersey) since 1960, and about doubled in the Mid-Atlantic region (New York/New Jersey to Virginia/Cape Hatteras) (Figure III.5.1).

Commercial

Nominal commercial catch reached its highest level since 1901 (Wilk 1977), at an estimated 7.3 thousand mt in 1983. Landings in 1985 were about 6.0 thousand mt. The commercial fishery accounts for about 10% of the total bluefish catch (Table III.5.1).

Research Survey Index

The NEFC Autumn Inshore Survey abundance index for strata between Cape Cod and Cape May has been used as an index of recruitment for bluefish on the Atlantic Coast, since it correlates well with various catch categories 2-4 years following the survey (Table III.5.2). The index jumped dramatically from 1974 to 1977, reaching a peak in 1979 (23.3 fish/tow). Since 1980, the index has varied between 10 and 20 fish/tow, with a 1985 value of 11.5 fish/tow (Table III.5.3, Figures III.5.2 and III.5.3). Because the NEFC Autumn Inshore Survey bluefish catch is dominated by YOY fish (<30 cm), its usefulness for purposes other than as a recruitment index is limited (Table III.5.4 and Figure III.5.4).

Summary

Although bluefish landings are down from the 1980 peak, they remain high relative to the catches of the 1960's. The level of the survey index since 1977 indicates that catches should remain at current levels for several years, barring drastic increases in fishing effort.

Estimates of mortality parameters for bluefish are lacking, due both to the recreational nature of the fishery and the wide-ranging, pelagic nature of the stocks. The MRFSS, 1979-1985, may provide data adequate for assessment.

Discussion: The ASFMC S&S subcommittee on bluefish presented their preliminary plans on assessment methodology.

Several approaches will be explored. One of the primary concerns is to develop an index of snapper (YOY) abundance from the MRFSS data. It was proposed that a CPUE index could be derived from the summer-fall catch of shore-based anglers (which is predominantly snappers) vs. the number of shore-based anglers as an index of effort. This MRFSS-CPUE index might then be correlated with the catch-per-tow from the NEFC autumn survey, and with catches by the boat-based recreational fishery one-year (or more) later. Preliminary calculations do not look promising, but the time series is short and refinements may improve the fit. The current NEFC snapper index of recruitment was calculated from data from Cape Cod to Cape May. Expansion of this to include a wider geographic area, perhaps to Cape Hatteras, would incorporate more of the stock into the recruitment index.

Stock assessment of bluefish will be difficult due to data limitations. The ASMFC Bluefish sub-committee intends to perform exploratory analyses of several types using length-frequency and effort data in order to develop a current age-length key, growth curves and mortality parameters for comparison with 1970's data presented by Wilk (1977). This may be pursued separately for the snapper and adult segments of the stock since they are captured by different modes of fishing. Much concern was expressed about the bimodal pattern of length-frequency distribution that appears both in the NEFC offshore trawl survey data (Table III.5.5) and in the recreational catches. This pattern may reflect the mixing of different stocks, differential migration by size, size-biased sampling by gear type, or a dominant year class phenomenom. In any event, it may be difficult to obtain a "representative" length-frequency distribution. This could cause problems in getting a Z value from catch-curve data.

Table III.5.1 Estimated bluefish catch: Atlantic Coast, 1960-1985 (000 kg).

YEAR	COMMERCIAL	RECREATIONAL*	FOREIGN	TOTAL
1960	1251	22950 (11475)	0	24201 (12726)
1961	1401	26686 (13343)	0	28076 (14744)
1962	2256	44674 (22337)	0	46930 (24593)
1963	2123	43326 (21663)	0	45449 (23786)
1964	1743	37238 (18532)	0	38981 (20274)
1965	1847	41054 (20522)	0	42901 (22369)
1966	2172	46219 (23110)	0	48391 (25282)
1967	1671	34094 (17051)	0	35765 (18722)
1968	2159	42327 (21376)	0	44486 (23535)
1969	2445	46139 (23295)	0	48584 (25741)
1970	2952	54047 (27018)	0	56999 (29969)
1971	2624	43373 (24073)	23	46020 (26720)
1972	3115	47202 (28578)	18	50335 (31711)
1973	4566	63859 (41890)	214	68639 (46670)
1974	4538	58932 (41663)	99	63569 (46300)
1975	4502	53354 (40018)	103	57859 (44523)
1976	4547	51674 (41327)	1	56222 (45874)
1977	4859	51967 (43655)	4	56830 (48461)
1978	4937	49873 (44882)	0	54810 (49819)
1979	5629	60300	0	65929
1980	6540	67758	0	74298
1981	7158	59935	0	67093
1982	6897	46528	0	53425
1983	7297	64625	0	71922
1984	5454	40125	0	45579
1985	6014	44972	0	50986

(-----): Adjusted Rec. Survey, Estimates for 1960, 1965. 1970; reduced by 50% with remaining years interpolated accordingly; Anderson 1980, Boreman 1983.

*Catch type (A + B)

Table III.5.2 Correlations (r values) between the NEFC abundance index for bluefish (stratified mean catch/tow, fall inshore survey, Cape Cod to Cape May) and commercial and total Atlantic Coast landings, 1974-1985.

Landings Measure	Years from Index to Landings Measure				
	0 (df=10)	1 (df=9)	2 (df=8)	3 (df=7)	4 (df=6)
Commercial	0.365	0.648*	0.862**	0.696*	0.741*
Total	0.027	0.413	0.541	0.024	0.019
Adjusted Total#	0.364	0.677*	0.743*	0.187	0.064

**p<0.01
*p<0.05

Summary Statistics:

NEFC Index:	Mean =	12.4	SD =	6.9	CV =	0.56
Commercial:	Mean =	5697	SD =	1061	CV =	0.19
Total:	Mean =	59877	SD =	8702	CV =	0.15
Adjusted Total:	Mean =	55350	SD =	11155	CV =	0.20

#) Anderson 1980, Boreman 1983

Table III.5.3 Bluefish - Index of Recruitment. NMFS/NEFC Autumn Inshore Trawl Survey - Cape Cod to Cape May.

Year	Stratified mean Catch/Tow (No.)	95% CI(Confidence Interval) high	low
1974	1.5	na	
1975	1.9	na	
1976	5.4	na	
1977	18.9	-12.9	50.6
1978	16.9	11.7	22.3
1979	23.3	18.9	27.5
1980	12.3	8.8	15.8
1981	18.4	11.4	25.4
1982	15.5	3.0	28.0
1983	8.5	1.2	15.8
1984	14.6	10.4	18.8
1985	11.5	4.6	18.3

Table III.5.4 Stratified mean catch (000 per tow) of bluefish samples in the NEFC Fall Inshore Trawl Surveys.

Year	Length (cm) 1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48	49-54	55-60	61-66	67-72	73-78	79-81
1974	619	9	1918	6405	487	217	132	0	0	0	0	20	16	0
1975	34	160	3265	8821	252	166	158	378	355	227	49	162	165	0
1976	1097	221	22114	17569	2059	320	560	41	71	127	99	0	28	21
1977	1439	339	23135	32311	487	140	74	23	106	36	53	113	63	12
1978	50	1400	1709	2409	3439	2337	77	17	86	119	186	85	0	0
1979	0	936	11219	48593	1510	398	827	599	939	275	133	122	0	126
1980	259	9290	2556	25655	6374	1882	207	0	75	77	32	72	123	16
1981	0	2934	41819	52613	3676	236	703	89	81	137	269	71	119	40
1982	980	678	2858	26298	2073	1019	203	35	56	14	5	0	0	25
1983	51	410	4119	14034	921	952	387	33	26	0	5	37	14	16
1984	0	3151	27983	23719	3600	729	228	83	78	92	82	19	72	0
1985	0	625	7941	6039	998	1411	262	40	261	62	46	5	41	0
Total	4529	20153	150636	211853	25876	9807	3818	1338	2134	1166	959	706	641	256

Table III.5.5 Stratified mean catch (000 per tow) of bluefish sampled in the NEFC Fall Offshore Trawl Surveys.

Year	Length (cm)													
	1-6	7-12	13-18	19-24	25-30	31-36	37-42	43-48	49-54	55-60	61-66	67-72	73-78	79-81
1967	0	0	0	0	0	0	0	0	0	0	24	48	0	0
1968	0	0	0	0	0	0	0	0	0	14	0	0	0	0
1969	0	0	0	0	0	0	28	28	52	0	0	24	14	0
1970	0	0	0	0	0	0	0	0	0	19	0	0	0	19
1971	0	0	0	0	0	0	0	0	26	70	89	21	0	0
1972	0	0	0	0	0	0	8	0	13	47	72	72	6	0
1973	0	0	130	939	18	0	0	14	0	0	25	99	39	0
1974	0	0	14	393	24	8	0	0	0	48	57	157	47	0
1975	0	0	0	30	24	32	6	13	18	30	16	67	54	5
1976	0	0	15	694	244	205	66	8	6	33	68	6	27	0
1977	24	0	20	311	21	6	0	0	7	7	21	80	50	0
1978	0	0	0	0	0	9	6	0	0	0	18	80	43	6
1979	0	0	0	0	10	0	0	4	20	34	68	45	72	14
1980	0	0	0	18	9	9	0	0	0	41	30	24	16	0
1981	0	0	43	1087	73	0	0	0	8	20	20	27	21	17
1982	0	0	0	7	9	34	39	8	43	44	44	41	38	25
1983	0	0	0	37	0	0	0	55	72	31	31	27	21	13
1984	0	0	49	49	0	0	22	0	37	6	0	39	13	0
1985	0	0	0	148	54	116	230	40	42	24	48	48	10	9
Total	24	0	271	3713	486	419	405	170	344	468	631	905	471	108

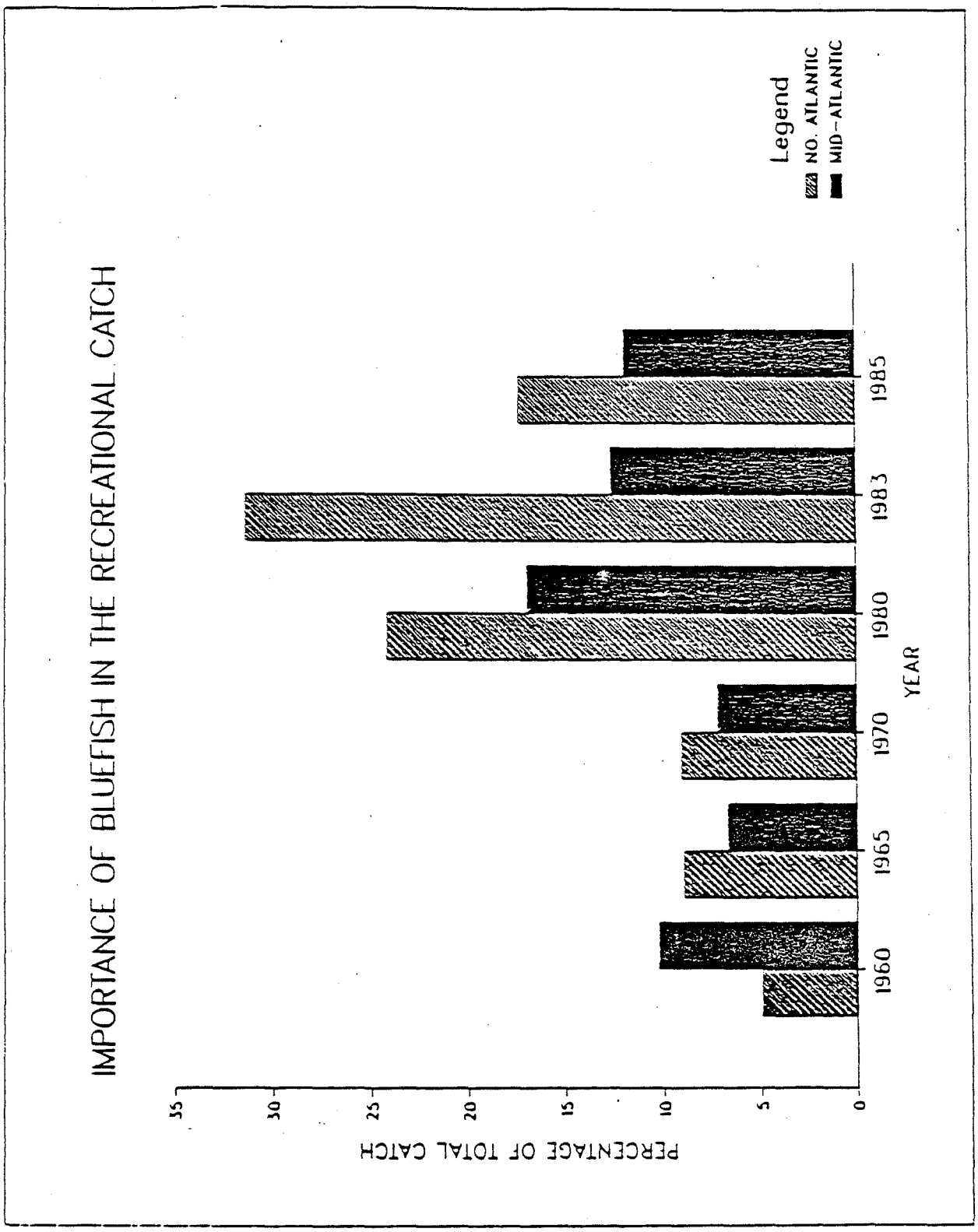


Figure III.5.1 Importance of bluefish as a component of recreational catch, North and Mid-Atlantic regions, 1960 - 1985.

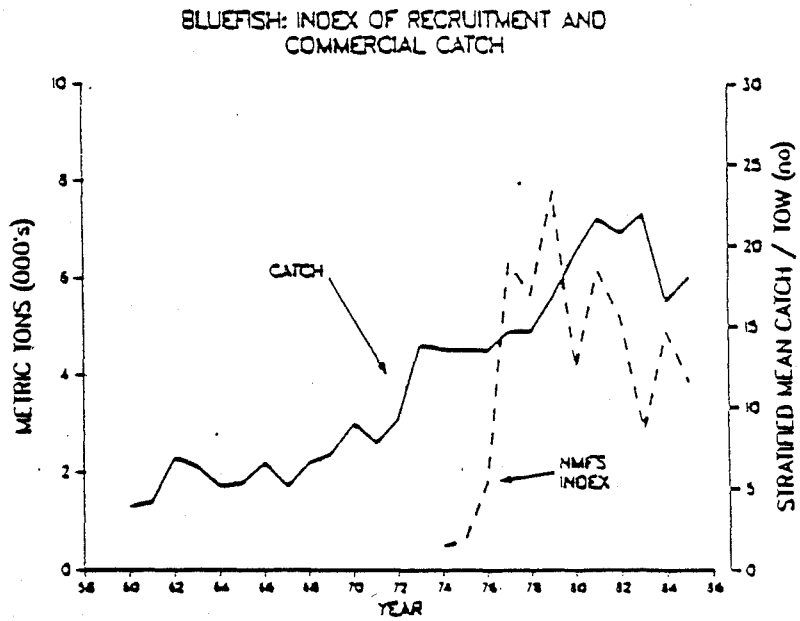


Figure III.5.2 Comparison of NMFS index of recruitment and commercial bluefish catch along the Atlantic Coast.

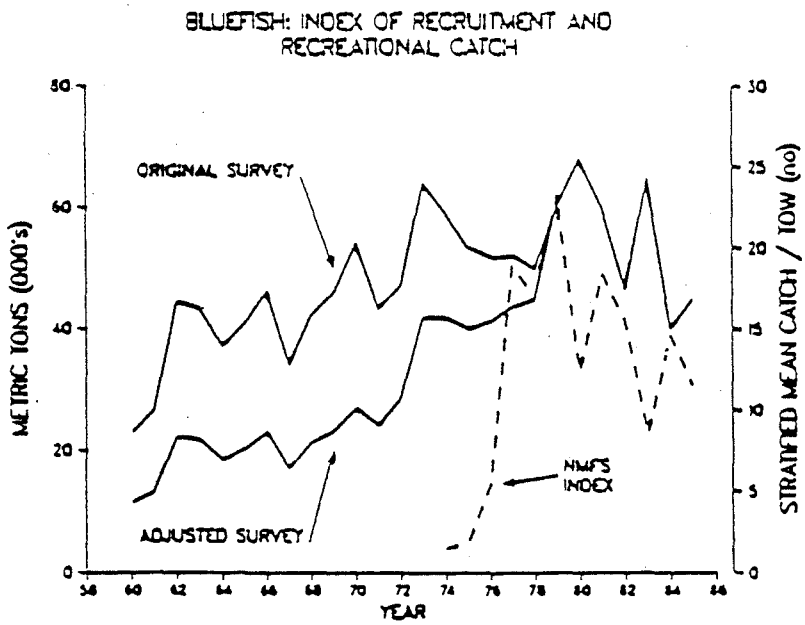


Figure III.5.3 Comparison of NMFS index of recruitment and recreational bluefish catch along the Atlantic Coast.

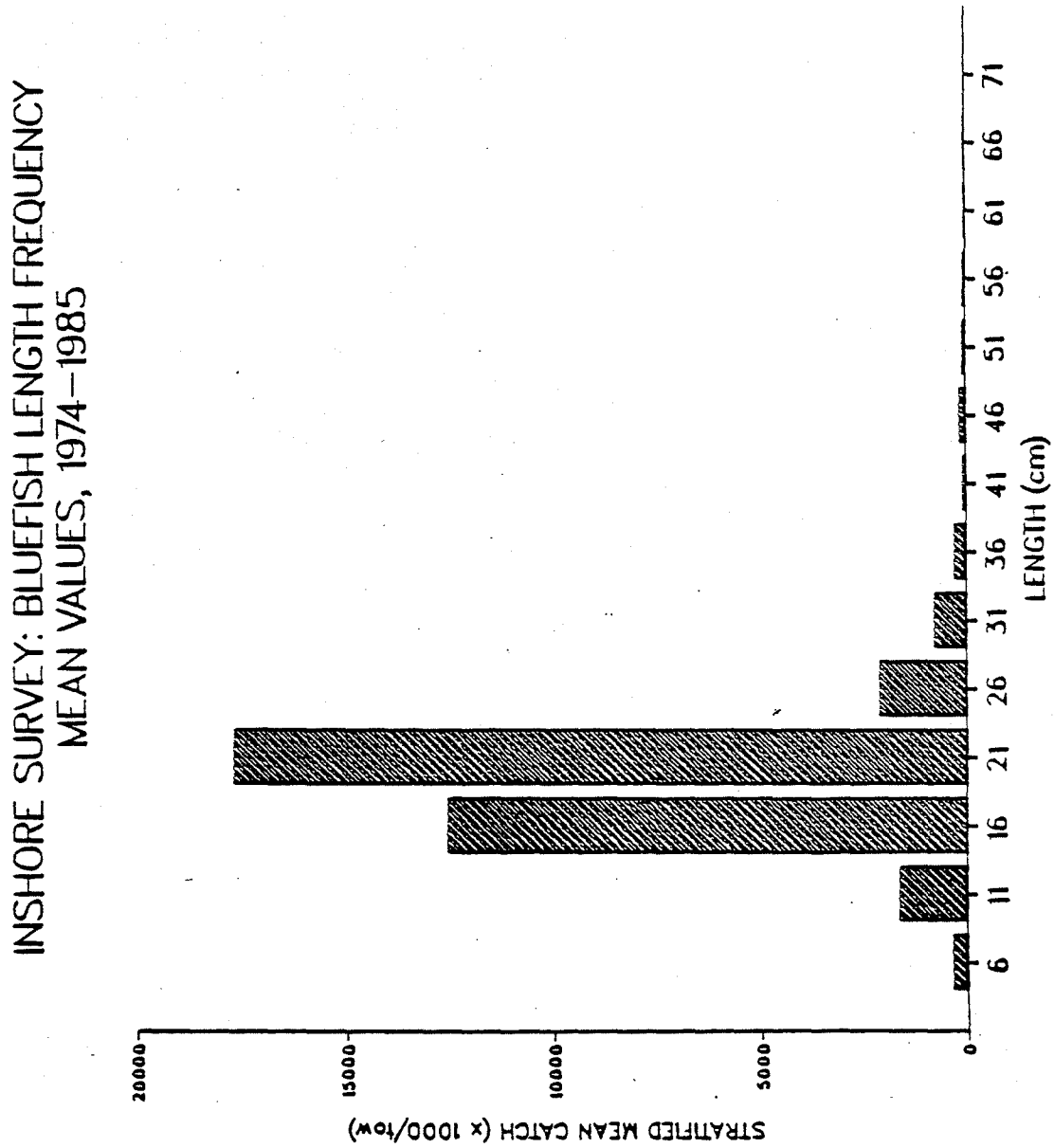


Figure III.5.4 Mean length frequency distribution of bluefish sampled by NEFC Fall Inshore Trawl Survey

1. ATLANTIC COD

Source Document: Serchuk, F. M. and S. E. Wigley. 1986. Assessment and status of the Georges Bank and Gulf of Maine Atlantic cod stocks - 1986. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-12. In REVIEW.

Summary: Annual commercial landings of Atlantic cod from the Georges Bank (NAFO Division 5Z and Statistical Area 6) and Gulf of Maine (NAFO Division 5Y) stocks, after steadily increasing from 30,100 metric tons (mt) in 1976 to 72,150 mt in 1982, sequentially declined to 49,400 mt in 1985. Cod was the dominant species landed in the 1985 USA Atlantic coast groundfish fishery, accounting for more catch, by weight, than any other single species. Estimated USA recreational landings of cod in 1985 were 9,000 mt, 67% higher than in 1984, but similar to the 1981-1983 average of 8,300 mt.

Commercial 1985 landings from the Georges Bank cod stock were 37,300 mt, 4% less than in 1984. USA and Canada accounted for 72% and 28%, respectively of the 1985 total. The USA catch was the lowest since 1978; the 1985 Canadian catch, 81% greater than in 1984, was the third highest since 1967. Total fishing effort in 1985 increased to a record-high level. Commercial CPUE, however, declined to a record-low. USA research vessel survey catch-per-tow indices in 1985 showed disparate patterns. The autumn indices were among the lowest ever (the autumn 1985 weight-per-tow value was a record-low) while the spring indices were relatively high. The elevated spring survey values however, are believed to reflect an increase in catchability rather than abundance since virtually all of the 1985 catch-at-age indices were higher than in 1984.

The strong 1980 and 1983 year classes were predominant in the 1985 Georges Bank landings. The 1983 cohort accounted for 51% of the total catch in numbers and 26% in weight. The 1980 year class accounted for 13% by number, and 25% by weight, of the 1985 yield. Both year classes were similarly dominant in the 1985 research vessel surveys.

Virtual population analysis of commercial catch-at-age data suggests that fishing mortality (F) on the Georges Bank stock doubled between 1978 and 1985 (0.40 to 0.82). During this same period, spawning stock biomass declined by half (95,500 mt in 1978 to 46,200 mt in 1985), with the 1985 biomass level the lowest in the time series (Figure IV.1.1). Parallel trends in F and biomass were also obtained from analyses of spring and autumn survey data. Yield per recurit calculations indicate that F in 1985 was far above $F_{0.1}$ (0.155) and F_{max} (0.280) (Figure IV.1.2). Although VPA-survey relationships show that the 1985 year class is above average in strength, continued fishing in 1986 at the 1985 F level will result in further declines in both total and spawning stock biomass (Table IV.1.1). If the 1986 catch approximates 30,000 mt (F=0.58) (likely based on Jan-Aug 1986 landings patterns), spawning stock biomass in 1987 will still be lower than in 1986, although total biomass will increase slightly (+3%) due to growth in weight of the 1985 year class. No rebuilding of total biomass can be expected during 1987 unless F in 1987 is reduced below F=0.58 and towards F_{max}.

Commercial Gulf of Maine cod landings in 1985 totaled 12,150 mt, 1% less than in 1984, and the lowest annual catch since 1979. USA landings (10,700 mt) were the lowest since 1976 while Canadian landings (1,450 mt), essentially unchanged from 1984, were half the 1983 level. Since substantial misreporting of Canadian Scotian Shelf (NAFO Division 4X) cod landings as being from the Gulf of Maine is believed to have occurred since 1982, recent total and Canadian landings trends are suspect. USA commercial fishing effort in 1985 increased to a record-high level while commercial CPUE remained at the historically low 1984 level. USA spring and autumn research survey indices in 1985 indicated an increase in stock abundance from 1984 although this increase may have been artifact caused by a change in survey trawl doors used in the 1985 (and subsequent) surveys. The spring 1986 survey indices were significantly lower than the 1985 spring values and about equal to the near record low 1984 values.

The 1985 USA commercial catch was dominated by the 1980-1982 year classes. Together these cohorts accounted for 82% of the 1985 USA landings by number and 76% by weight. The same three year classes were predominant in the 1985 research vessel surveys. Both the autumn 1985 and spring 1986 surveys indicated that the 1985 Gulf of Maine cod year class may be strong.

Estimates of fishing mortality derived from analyses of USA research vessel survey data indicated that F during 1982-1985 was 0.62, about twice the 1977-1981 F level (0.32) and well above F_{max}(0.30). Given the current record-high effort, low commercial CPUE values, and low survey abundance indicators, short-term annual yields at the 1985 level (12,000 mt) do not appear to be sustainable. Presently, potential yield and stock reproductive potential can be enhanced by reducing F towards F_{max}.

Discussion

Initial discussion centered on the idea of "safe biological limits" for a stock. This concept is used by ICES to evaluate the current status of all stocks that they review. A series of questions were posed that are paraphrased as follows:

(1) Is recruitment reduced at the lowest levels of spawning stock?

(2) Is the spawning stock at a level that is lower that previously observed?

(3) Does biomass show a declining trend in the short-term?

(4) What level of F would reduce the spawning stock to historic low levels in the short-term?

The issue of whether these criteria are too drastic came up, but it didn't seem so to the group. The ICES experience in using this idea as a term of reference for each stock was further discussed.

The recreational fishery for cod was reviewed. One of the problems identified was that recreational landings (for all species including cod) are not recorded by NMFS statistical areas hampering the proration of landings among stocks. It was also mentioned that post stratification of the present data base would be difficult. Because of this problem and others the recreational data were summarized but not used in either the Georges Bank or Gulf of Maine assessments. The question of the ratio between recreational and total commercial catches was discussed and it seemed to be about 14% on average. The fact that party and head boats do go to Georges Bank and that Southern New England boats fish on the winter distribution of cod was considered relevant.

Gulf of Maine Stock

A summary of the status of this stock showed that commercial CPUE, survey indices and other measures of abundance are at historic low levels. The current levels of F are far above the biological reference parts of F_{max} and $F_{0.1}$ The consensus of the group was that the stock was in poor condition.

A question was asked of whether the effect of discarding in the small mesh fishery was included in the analysis. Since the survey index tracks abundance independent of individual fisheries the survey results integrate all sources of mortality. Survey total mortalities, Z's, were somewhat variable, but show an increasing trend and are presently at historic highs. The precision of the survey Z's cannot currently be evaluated without a VPA.

The question of uncertainty of levels of F in recent years was dismissed as an impediment to conclusions on the status of this stock because all the biological, survey, and commercial indicators suggest a significant decline in abundance. A VPA was not needed to conclude that the stock is in a state of overall decline. The group felt that growth overfishing was occurring on this stock and that recruitment overfishing was a possibility, although less certain.

Georges Bank Stock

Derivation of the catch at age matrix used in the VPA was described in detail. Problems with Canadian sampling and age reading necessitated an assessment based entirely on US sampling data and aging methods. A question was asked about the selectivity of Canadian longline gear. It appears that few scrod are taken by this gear due to size of hook used in the fishery. Canadian length frequencies are very similar to those from the US, but the number of length frequency samples taken annually by Canada has generally been low except during 1985. Further discussion of Canadian length frequency data ensued. Data from 1984 and earlier were considered as inadequate due to small sample size, but a comparison of Canadian and USA catch at age from 1985 appeared justified. In recent years there seemed to be a tendency for Canadian aged fish to be older than USA aged fish of the same length.

The question of whether the US and Canada have the same mesh regulation on Georges Bank was discussed. The Canadian regulation is 5 1/4" while the US has a 5 1/2" limit. The effective mesh for both countries is unknown, however, but is probably considerably smaller than the regulated size.

Some discussion of the effect of technological innovations on fishing power of vessels in the fishery occurred. It was concluded that this was a generic problem in interpreting any fishery effort series, but no recommendations for adjusting the cod effort data were made. It was felt that conversion to Loran C had probably occurred prior to the 1978-85 decline in CPUE that was shown. Further, only the 1978-85 data were used in the VPA. It was suggested that the smoothed survey catch might be used as ground truth for comparison to commercial data to sort out the fishing power question.

The survey indicies were discussed with respect to seasonal availability changes. A component of the Georges Bank stock migrates south in winter. The group felt that the autumn survey was the better of the two for tracking abundance.

The VPA was tuned with the survey biomass and commercial effort data. Four criteria were used to judge the most appropriate terminal F value. Both survey and commercial data gave good fits, but the commercial effort series gave the best. It was felt that if a smoothed survey series was used a similar fit would be obtained. The idea of tuning terminal F using the procedures in the asssessment was accepted, but the question of whether the fit kept improving with increased F was considered important. The criteria began to drop off at higher F's, however. Accordingly, a terminal F of 0.82 was selected.

When the VPA was examined, the problem of excluding recreational landings was again discussed. The problem might generally explored by artificially increasing M or systematically changing the catch at age matrix. The SVPA results included in the assessment were used as a general guide for determining the partial recruitment pattern in the stock but the group noted that further exploration of the SVPA procedure was warranted.

Two options for F in 1986 were considered in the short-term catch and stock size projections: (1) $F_{86} = F_{85} = 0.82$; and (2) $F_{86} = 0.58$ corresponding to a likely 1986 commercial catch of 30,000 mt. Under either option, spawning stock biomass (SSB) would be lower at the beginning of 1987 than in 1986. The group noted that the assumed reduction in F from 1985 to 1986 was largely due to a substantial increase in age 3+ biomass as the strong 1983 year class recruited to the fishery. However, the group cautioned that this increase will likely be short lived under current levels of fishing mortality. Lowering F to F_{max} or $F_{0.1}$ in 1987 would result in a significant increase in SSB in 1988.

In summary the group felt that the assessment results were fairly robust to the identified uncertainties in the VPA and projection results. Survey indices, commercial CPUE, changes in age composition and other factors all point to significant declines in stock abundance. The stock appears to be growth overfished and perhaps in danger of recruitment overfishing.

Table IV.1.1 Short-term catch and stock size projections for Georges Bank cod, 1986 - 1987. Biomass and catch values are expressed in thousands (000's) of metric tons. Spawning stock biomass is considered to be age 3+ and refers to the beginning of the year.

1986				1987					1988	
Stock Biomass	Spawning Stock Biomass	$\bar{F}_{(3-7)}$	Catch	Mgmt Option	Stock Biomass	Spawning Stock Biomass	$\bar{F}_{(3-7)}$	Catch	Stock Biomass	Spawning Stock Biomass
89.3	53.9	0.82	28.6	$F_{87} = F_{85}$	83.1	39.5	0.82	35.5	78.9	42.8
		0.58	30.0	$F_{87} = F_{86}$	92.4	48.7	0.58	32.0	93.3	57.1
		0.58	30.0	F_{max}			0.28	17.4	108.7	72.4
		0.58	30.0	$F_{0.1}$			0.16	10.1	116.4	80.1

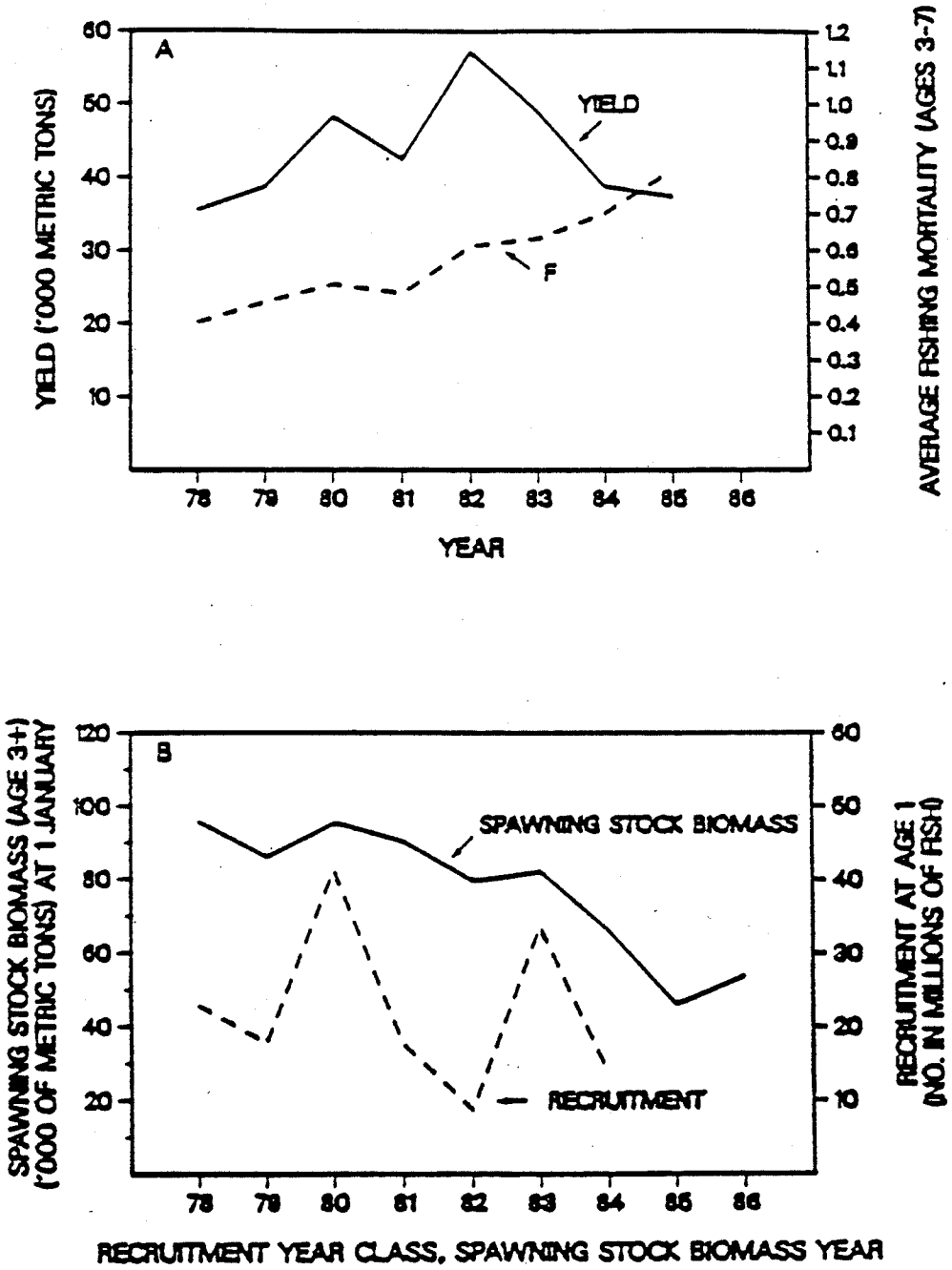


Figure IV.1.1 (A) trends in yield and fishing mortality; and (B) trends in spawning stock biomass (age 3+) and recruitment (at age 1) for Georges Bank and South (NAFO Division 5Z and Statistical Area 6) Atlantic Cod.

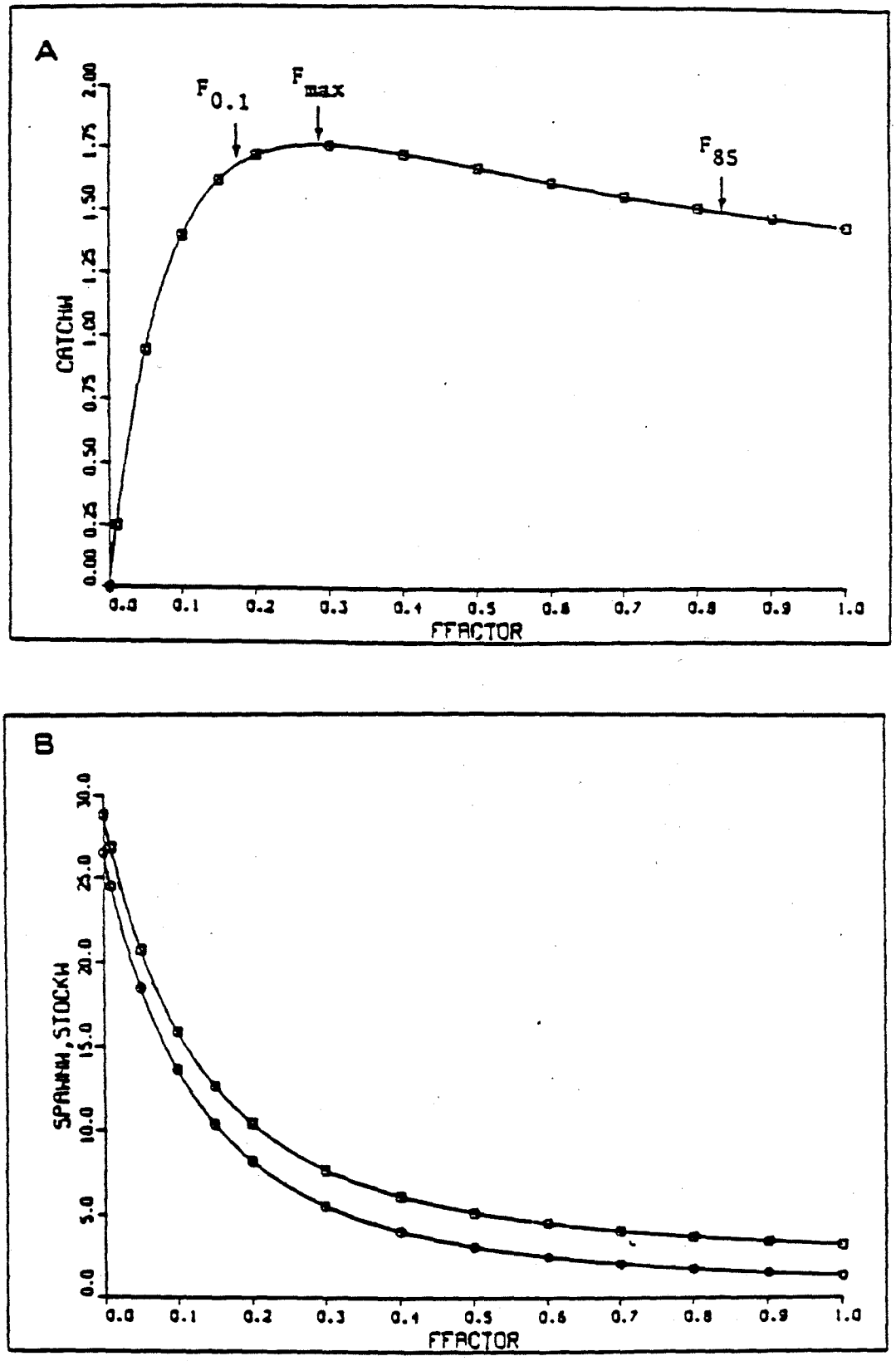


Figure IV.1.2 (A) Long-term yield per recruit; and (B) long-term total stock and spawning stock biomass per recruit relationships for Georges Bank and South (NAFO Division 5Z and Statistical Area 6) Atlantic Cod.

2. POLLOCK

Source Document: McGlade, J., M.C. Annand, and D. Beanlands. 1985. The Exploitation and Biological Status of Pollock in Divisions 4VWX and Subarea 5. CAFSAC Research Document 85/99. 90 p.

Mayo, Ralph K. and S. H. Clark. 1984. An Assessment of the Pollock (*Pollachius virens* L.) Stock in the Scotian Shelf, Gulf of Maine and Georges Bank Region, 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-13. 42 p.

Fishery Trends

The total nominal commercial catch for this stock increased from about 7,000 metric tons (t) annually during the mid 1920's to an annual average of 38,000 t from 1960-1966 (Figure IV. 2.1). Catches then declined to an average of 24,500 t between 1967 and 1971 and again increased to an average of 38,200 t from 1972-1977. Since 1980, annual catches have generally exceeded 50,000 t; the 1985 nominal catch exceeded 63,000 t, the highest level observed in the historical record

Canada and the United States have consistently accounted for the largest share of the landings. USA landings increased from approximately 5,000 t during the 1920's to an annual average of 13,400 t from 1935-1960 (Figure IV.2.1). Landings were generally stable after the early 1940's, apparently reflecting stable levels of effort in the haddock fishery in which significant quantities of pollock were taken as by-catch. In contrast, nominal catches by Canada rose continually from an average of 5,100 t from 1920 to 1942 to an average of 29,300 t between 1960 and 1964 (Table IV.2.1, Figure IV.2.1). USA landings declined to 3,500 t during the late 1960's but have since risen to an average of 17,000 t since 1980; Canadian landings declined to 10,800 t in 1970, increased to an average of 25,600 t during 1973-1978 and have since risen to an average of 37,200 t since 1980 (Table IV.2.1, Figure IV.2.1). In 1985, both USA and Canadian landings rose substantially, resulting in a 23% increase in total landings over 1984.

Distant water fleet (DWF) catches of pollock have been primarily incidental, with the major share taken by USSR trawlers fishing for silver hake and other groundfish on the central and southern Scotian Shelf and on Georges Bank in summer and autumn. Nominal catches for the USSR peaked at 9865 t in 1966, declined sharply during the late 1960's, and then rose to over 2,000 t annually between 1971 and 1975 (Table IV.2.1). Since 1980, catches by DWF vessels have averaged less than 1,000 t annually.

Since 1960, the major portion of the catch has been taken on the Scotian Shelf with most of the remainder being about evenly distributed between Georges Bank and the Gulf of Maine (Table IV.2.2). The Canadian catch has been taken primarily on the Scotian Shelf (89%), while USA catches were more

evenly divided between Georges Bank (47%), the Gulf of Maine (36%), and the Scotian Shelf (18%) during 1960-1971, but have subsequently been taken primarily in the western Gulf of Maine (>60%). The Canadian fishery has evolved over the past decade from one in which pollock were taken incidentally to a directed fishery that is prosecuted by large offshore trawlers on the northern and central Scotian Shelf and Georges Bank, and to an inshore fishery conducted by smaller vessels using both mobile and fixed gear on the southwestern Scotian Shelf and in the eastern parts of the Gulf of Maine and Georges Bank. The USA Georges Bank catch was taken primarily in summer and autumn by larger trawlers in directed operations for cod, haddock, and other demersal species in the Great South Channel area and along the Northern Edge and Northeast Peak, while most of the USA Gulf of Maine catch has been taken incidentally or in operations directed towards spawning migrants by small trawlers and gillnetters in the Jeffreys Ledge region in autumn and winter (Figures IV.2.2 and IV.2.3). USA catches have been primarily taken by trawlers, although the portion taken by gillnets increased from less than 10% during 1971-1972 to 40% of the total during 1978-1981 before declining to 25-30% of the total during 1983-1985 (Table IV.2.3).

Recreational catch data for pollock are limited. No data are available for Canada and it is assumed that Canadian recreational catches are of minor importance. USA recreational catch estimates (Table IV.2.4) obtained for 1960, 1965, and 1970 totalled 9,834 t, 4,240 t, and 2,533 t, respectively. Since 1980, the USA recreational harvest of pollock has averaged 866 t per year. Except for 1982 and 1983, the mean weight of recreationally caught pollock has been less than 0.5 kg, suggesting that most of the catch has been comprised of immature harbor pollock.

Commercial Catch per Unit Effort

Commercial catch per Unit Effort (CPUE) indices were computed for USA tonnage class 3 (51-150 GT) and 4 (151-500 GT) side and stern trawlers, and Canadian class 5 (501-999) stern trawlers using nominal catch and effort data from trips in which pollock represented 50% or more of the total landed weight, or was recorded as the main species for the trip. Computations were performed on an annual basis and for selected seasons chosen to reflect periods when pollock were either highly aggregated or widely dispersed through the region. Results for the Canadian and USA fisheries suggest that increased concentrations of pollock during the winter spawning season can generate transient increases in availability sufficient to produce consistently high annual CPUE indices independent of the overall level of stock abundance. This is particularly so when the exploitation rate is relatively low. In this case, changes in seasonal availability are great enough to mask the effects of changes in stock abundance on the calculation of CPUE. Conversely, CPUE indices which are based on trips fishing during the remainder of the year provide a more reasonable measure of relative stock abundance since availability effects are minor compared to actual abundance.

Results for USA class 3 and 4 vessels during March through September and Canadian class 5 vessels in January through June (Figure IV.2.4) suggest that pollock abundance has increased considerably since the early 1970's. USA results further indicate that current abundance is below the peak level which existed during the late 1970's. Indices for Canadian class 5 vessels have continued to increase through the early 1980's, although declines in CPUE of about 50% are evident for both USA and Canada in 1985.

Commercial Catch at Age

Estimates of fish landed and corresponding mean weights at age for the commercial fishery are available from 1970 through 1985. Age compositions were obtained by applying various combinations of Canadian and USA length and age samples to monthly and quarterly commercial landings for otter trawls and gillnets as described by Mayo and Clark (1984) and McGlade et al. (1985). Combined results for all countries (Table IV.2.5) reveal that the catch has been dominated by age 3-5 fish (70% of the 1970-1985 total). The 1971, 1975, and 1979 year classes have dominated the commercial landings over the years, although catches of 1969, 1974, and 1976 year classes have also been reasonably high. Mean weights at age for this stock appear in Table IV.2.6. Values for 1970 through 1976 are based on Canadian sample data; values for 1977 through 1984 represent averages for Canadian and USA fisheries, weighted by numbers landed at age. Mean weights fluctuate over time, but no consistent trends are evident.

Research Vessel Surveys

Bottom trawl surveys have been conducted by the NEFC in offshore waters of the Gulf of Maine and Georges Bank during autumn and spring since 1963 and 1968, respectively. Summer surveys of the entire Scotian Shelf and Bay of Fundy have been conducted since 1970 by Canadian research vessels. The Commonwealth of Massachusetts has surveyed inshore waters of the western Gulf of Maine between Cape Cod and the Merrimack river each spring and autumn since 1978. Results for pollock reveal a general increase in relative abundance and biomass through the late 1970's and early 1980's, followed by a sharp decline through 1984. Massachusetts DMF surveys appear to be particularly useful for monitoring incoming recruitment given the proximity of the survey region to known western Gulf of Maine spawning grounds. Age 1 indices from the 1980 DMF survey identified the strong 1979 year class, and the 1983 survey indicated the presence of the comparatively strong 1982 year class.

Virtual Population Analysis

Estimates of instantaneous fishing mortality (F) (Table IV.2.7) stock size (Table IV.2.8) and stock biomass (Table IV.2.9) were obtained by Virtual Population Analysis (VPA) of the catch at age matrix (Table IV.2.5) assuming an instantaneous natural mortality rate (M) of 0.20. Terminal F in 1985 (0.73) was computed from the functional relationship between F and fishing effort as described by Mayo and Clark (1984) using 1985 effort of 15,254 days fished based on USA tonnage class 3 otter trawl CPUE indices (Figure IV.2.5).

Partial recruitment in 1985 reflected the most prevalent pattern observed over time in the otter trawl fishery with full recruitment occurring at age 5 and the following partial selection coefficients: age 2, 0.038; age 3, 0.300; age 4, 0.723. Age-specific stock biomass estimates were derived from stock size estimates by applying commercial mean weights at age as given in Table IV.2.6.

VPA results suggest that F remained relatively stable between 1970 and 1980, ranging from approximately 0.3 to 0.4, except in 1973 when extremely high values for the 1968 and 1969 year classes increased the mean F to 0.52. Fishing mortality increased sharply in 1981 and 1982; the 1985 terminal F estimate of 0.73 further suggests that recent mortality levels are above the long term average and the F0.1 (0.19) and Fmax (0.45) levels.

Stock size and biomass estimates exhibit considerable variability throughout most of the period for which data are available. Much of the variability in total stock size since the mid-1970's results from recruitment of the strong 1975, and 1979 year classes, which have supported the fishery since the late 1970's. Similarly strong 1969 and 1971 year classes predominated during the early 1970's. The 1982 year class does not appear to be as strong as previous estimates would suggest. Maximum stock size levels occurred during the late 1970's while estimates for the most recent years have declined sharply, a result of high mortality rates evident since 1981. Recruitment at age 2 in 1986 (38.6 million fish) was estimated based on average levels observed over the 1970-1983 period.

Catch and Stock Size Projections

Stock sizes were projected on a short-term basis using the 1985 age-specific stock sizes as a base level, with various levels of F employed for 1986 and 1987. Partial recruitment and natural mortality were as assumed above, and recruitment at age 1 in 1986 and 1987 were set at the mean level (38.6 million fish) computed for 1970-1983. Stock biomass and catch weights were computed by applying 1985 mean weights at age. Long-term equilibrium projections were also performed with the same set of assumptions.

Short-term projections based on 1985 stock levels indicate a probable reduction in stock biomass and catch in the near future regardless of the level of fishing mortality applied (Table IV.2.10). If F is held at the 1985 level (0.73) through 1987, landings will decline by 54% and age 3+ stock biomass will be reduced by 42% from the 1985 level. If F is reduced to 0.33 by 1987, landings will decline by approximately 73% and stock biomass will decline by 35% from the 1985 levels.

Equilibrium projections assuming a constant recruitment level of 38.6 million fish suggest that fishing at F0.1 (0.19) would provide a long-term yield of 49,500 t from an age 3+ stock biomass of 290,000 t; a maximum long-term yield of 56,900 t may be obtained from a corresponding stock biomass of 158,000 t at an Fmax level of 0.45 (Figure IV.2.6). A long-term fishing strategy employing an F of 0.73 would produce an equivalent yield of about 56,000 t, but at a greatly reduced stock biomass of approximately 106,000 t.

Thus, continued fishing at the current level of F (0.73) would provide only marginal increases in yield (+13%) over that which would be obtained by fishing at the F0.1 level and a slight reduction from that which would be obtained by fishing at Fmax.

Discussion: Catch trends in the Northwest Atlantic pollock fishery were reviewed, indicating substantial increases in 1985. Potential problems in reporting accuracy were identified as a possible cause of unexpectedly high Canadian pollock landings in 1985.

The high variability of survey index data for pollock, specifically from the NEFC trawl surveys, initiated a discussion of the potential merits of species-directed surveys and the relative merits of surveys in general. Could the survey be modified to improve the time series of pollock relative abunddance? The potential application of hydro-acoustic methods and sample stratification strategies for specific species were discussed. No single alternative appeared to offer a solution to the pollock problem in light of the overall requirements, terms of budget and data requirements for other species, of the survey itself.

Concern was expressed over the lack of correlation of VPA results for the 1982 year class, with inshore survey data. However, the 1982 year class will not be fully recruited to the fishery until 1987. Thus, subsequent years' data will be required to verify the predictive capabilities of the inshore survey.

Yield and stock biomass projections for 1986-1987 were presented. With the size of the 1982 year class yet to be determined, continued fishing at present (F = 0.73) or higher F values would result in substantial declines in stock biomass.

VPA analyses were tuned by examining results incorporating a series of terminal F's, and using several convergence criteria suggested by Workshop participants. Tuning of the VPA was based on fishing effort (f) versus fishing mortality (F) relationships.

The results of the VPA indicated increasing F and decreasing stock size in 1985. Decreasing U.S. cod and haddock catches have resulted in increased effort directed to pollock. Considering that 1986 pollock landings appear to be slightly above 1985 landings, F for 1986 is expected to exceed previous projections and may approach 1.0.

It was pointed out that the application of smoothing techniques to the survey data time series for pollock did not improve the correlation of that data to CPUE data from other sources.

A suggestion was made that an absence-presence at station index for pollock abundance might be useful in light of the problems associated with the survey relative abundance data.

Table IV.2.1 Commercial landings of pollock (metric tons, live) by country for Divisions 4VWX and Subareas 5 and 6.

Year	Canada	Fed Rep Germany	German Dem. Rep.	Japan	Spain	USSR	United Kingdom	USA	Other	Total
1982	38029	-	-	3	-	297	-	14357	128	52814
1983	32749	-	-	6	-	226	-	13967	283	47231
1984	33238	-	-	1	-	118	-	17762	123	51242
1985	43302	-	-	17	-	336	-	19341	143	63139

Table IV.2.2 Commercial landings of pollock (metric tons, live) for Divisions 4VwX, Subarea 5, and Statistical Area 6.

Year	4V	4W	4X	Total* 4VWX	5Y	5Ze	5ZW	Total 5Z	5N	Total SA 5	SA6	Total
1982	2939	9375	21036	33348	9416	9903	15	9918	129	19463	3	52814
1983	5491	5787	18137	29415	8458	9217	25	9242	113	17813	3	47231
1984	4397	5784	19352	30751	12525	7819	28	7847	113	20485	6	51242
1985	12087	3262	26837	42186	15614	5168	18		150	20950	3	63139

* Includes NK

Table IV.2.3 Commercial landings of pollock (metric tons, live for the Scotian Shelf, Gulf of Maine Georges Bank, and Southern New England-Middle Atlantic areas by gear type and country.

	Bottom Trawls				Gill Nets			Other Gear				All Gear			
Year	Canada	USA	Others	Total	Canada	USA	Total	Canada	USA	Others	Total	Canada	USA	Others	Total
1982	27055	9793	428	37276	8029	4342	12371	2945	222	-	3167	38029	14357	428	52814
1983	25729	10630	515	36874	5421	3121	8542	1599	216	-	1815	32749	13967	515	47231
1984	25850	12871	242	38943	-	4736	-	-	155	-	-	33238	17762	242	51242
1985	-	13659	-	-	-	5608	-	-	74	-	-	43302	19341	496	63139

Table IV.2.4 USA Catches of pollock (numbers, total weight, and estimated mean weight in kilograms) as estimated from data collected in USA recreational fishery surveys.

Year	Number (00's)	Weight (tons)	Mean Weight (kg)
1979	3,648 (2,349)	1,021 (658)	0.28
1980	4,446 (1,997)	2,134 (959)	0.48
1981	2,724 (1,602)	1,226 (721)	0.45
1982	1,686 (882)	2,563 (1,341)	1.52
1983	1,314 (590)	2,799 (1,257)	2.13
1984	642 (405)	276 (174)	0.43
1985	2,147 (1,860)	862 (747)	0.40

Numbers in parentheses exclude data for pollock caught and released alive; weights calculated by multiplying numbers caught by mean weight of pollock available for identification in intercept (creel) survey work.

Table IV.2.5. Estimated catch at age (1000's of fish) for Gulf of Maine - Georges Bank - Scotian Shelf pollock.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
						CATCH AT AGE						
2	146.0	1077.0	845.0	2063.0	525.0	314.0	253.0	118.0	478.0	332.0	694.0	645.0
3	620.0	2075.0	2346.0	2862.0	8341.0	1970.0	2058.0	1727.0	9521.0	4748.0	890.0	2709.0
4	2136.0	2362.0	4266.0	9973.0	3863.0	6188.0	2967.0	3804.0	4707.0	8563.0	3687.0	1308.0
5	1554.0	2047.0	2281.0	5615.0	3888.0	2452.0	4860.0	2515.0	3479.0	4293.0	6197.0	3919.0
6	1031.0	1624.0	1183.0	877.0	1520.0	2535.0	1456.0	3021.0	1633.0	2312.0	3738.0	4641.0
7	782.0	620.0	574.0	406.0	729.0	1056.0	1610.0	1050.0	1924.0	824.0	1582.0	2822.0
8	468.0	278.0	273.0	269.0	465.0	459.0	420.0	688.0	587.0	603.0	502.0	1021.0
9	216.0	40.0	246.0	260.0	288.0	167.0	90.0	203.0	392.0	166.0	391.0	288.0
10	144.0	136.0	111.0	105.0	209.0	102.0	76.0	91.0	150.0	109.0	135.0	316.0
11	57.0	209.0	97.0	113.0	371.0	83.0	59.0	51.0	100.0	43.0	48.0	74.0
TOTAL	7154.0	10468.0	12222.0	22543.0	20199.0	15326.0	13849.0	13268.0	22971.0	21993.0	17864.0	17743.0

AGE	1982	1983	1984	1985
2	204.0	83.0	67.0	222.0
3	4578.0	2588.0	1252.0	2316.0
4	2292.0	11429.0	5219.0	2743.0
5	857.0	1911.0	9913.0	5676.0
6	2612.0	435.0	1186.0	7785.0
7	2612.0	895.0	201.0	1345.0
8	1341.0	1027.0	367.0	205.0
9	834.0	550.0	364.0	230.0
10	280.0	302.0	198.0	336.0
11	203.0	144.0	68.0	301.0
TOTAL	15813.0	19364.0	18835.0	21159.0

Table IV.2.6. Estimated mean weights (kg) at age in the commercial fishery for Gulf of Maine - Georges Bank - Scotian Shelf pollock.

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	0.97	1.54	1.00	0.83	0.83	0.86	0.63	0.80	0.43	0.73	0.56	0.62	0.62	0.78	1.05	0.74
3	1.66	2.14	1.75	1.36	1.43	1.30	1.25	1.14	0.57	1.14	1.38	1.46	1.14	1.19	1.30	1.04
4	2.49	1.96	2.76	1.90	1.97	2.05	1.94	1.64	1.51	1.50	1.93	2.40	2.57	1.75	2.13	1.94
5	3.48	2.91	4.18	2.64	3.01	3.21	2.80	2.62	2.65	2.71	2.68	2.94	3.51	3.02	2.61	2.77
6	4.22	3.70	4.98	3.96	4.05	3.96	3.73	3.52	3.88	3.53	3.42	3.44	4.14	4.15	3.46	3.26
7	5.27	4.62	5.59	4.85	5.03	5.12	4.64	4.53	4.59	4.75	4.21	4.31	4.53	4.90	5.14	3.78
8	6.12	5.73	6.13	6.14	6.08	6.53	5.60	5.66	5.73	5.67	5.72	5.73	5.29	5.24	5.72	5.19
9	7.40	5.44	6.38	6.60	6.62	7.55	7.04	6.77	6.55	6.72	6.46	6.73	6.29	6.07	5.87	6.38
10	7.02	8.02	7.15	7.27	7.21	7.69	7.61	7.06	6.77	7.10	7.78	7.72	7.32	6.58	6.53	6.34
11	9.14	9.00	6.29	9.33	8.14	8.47	8.60	8.54	7.56	8.31	8.00	7.71	7.96	7.72	7.45	7.84

Table IV.2.7. Estimates of instantaneous fishing mortality (F) derived from virtual population analysis (VPA) of Gulf of Maine - Georges Bank - Scotian Shelf pollock.

AGE	YEAR 1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
	FISHING MORTALITY											
2	0.005	0.026	0.034	0.043	0.023	0.009	0.006	0.002	0.016	0.044	0.034	0.009
3	0.050	0.089	0.073	0.154	0.241	0.111	0.075	0.052	0.211	0.218	0.159	0.183
4	0.258	0.271	0.264	0.496	0.319	0.283	0.242	0.193	0.197	0.299	0.263	0.368
5	0.282	0.422	0.455	0.658	0.366	0.345	0.376	0.332	0.270	0.278	0.367	0.492
6	0.290	0.534	0.462	0.317	0.370	0.433	0.355	0.424	0.375	0.290	0.415	0.519
7	0.510	0.284	0.364	0.283	0.473	0.477	0.545	0.469	0.529	0.329	0.330	0.640
8	0.629	0.342	0.195	0.290	0.609	0.624	0.353	0.476	0.524	0.311	0.342	0.369
9	0.365	0.097	0.577	0.287	0.576	0.460	0.234	0.288	0.550	0.273	0.341	0.337
10	0.344	0.413	0.419	0.524	0.395	0.412	0.393	0.394	0.358	0.288	0.373	0.512
11+	0.344	0.413	0.419	0.524	0.395	0.412	0.393	0.394	0.358	0.288	0.373	0.512
MEAN F	0.344	0.413	0.419	0.524	0.395	0.412	0.393	0.394	0.358	0.288	0.373	0.512
AGES	5+	5+	5+	5+	5+	5+	5+	5+	5+	5+	5+	5+

AGE	1982	1983	1984	1985
2	0.007	0.007	0.005	0.028
3	0.079	0.109	0.143	0.219
4	0.232	0.287	0.331	0.528
5	0.440	0.308	0.434	0.730
6	0.725	0.420	0.320	0.730
7	0.629	0.591	0.350	0.730
8	0.732	0.547	0.518	0.730
9	0.585	0.778	0.380	0.730
10	0.641	0.435	0.730	0.730
11+	0.641	0.435	0.422	0.730
MEAN F	0.641	0.435	0.422	0.730
AGES	5+	5+	5+	5+

Table IV.2.8. Estimates of stock size (1000's of fish) derived from virtual population analysis (VPA) of Gulf of Maine - Georges Bank - Scotian Shelf pollock.

STOCK SIZE

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
2	33087.4	45948.5	27906.3	54601.5	25866.2	38704.5	45746.6	67172.8	33033.2	8505.3	22573.1	81768.8
3	14044.7	26967.5	36660.0	22086.2	42851.1	20706.9	31438.3	37229.8	54928.5	26627.2	6663.0	17855.2
4	10309.0	10937.1	20208.3	27900.9	15504.1	27579.9	15177.7	23884.3	28923.9	36402.2	17527.4	4653.7
5	6953.1	6519.2	6830.7	12708.4	13907.8	9222.6	17017.4	9757.2	16129.7	19443.2	22107.0	11034.6
6	4494.1	4295.6	3501.3	3547.6	5387.4	7895.9	5348.6	9570.0	5729.3	10077.3	12058.6	12536.1
7	2142.6	2752.7	2062.8	1806.2	2116.5	3046.2	4191.0	3071.6	5125.5	3224.8	6172.2	6519.3
8	1094.8	1053.8	1696.3	1173.5	1113.7	1079.4	1547.7	1990.0	1573.6	2473.4	1900.0	3632.2
9	775.4	478.0	613.0	1143.1	719.0	496.0	473.4	889.9	1012.7	762.7	1483.2	1104.7
10	542.1	440.9	355.3	281.8	702.1	331.0	256.4	306.6	546.1	478.2	475.2	863.2
11+	214.6	677.5	310.5	303.3	1246.4	269.3	199.0	171.8	364.1	188.7	169.0	202.1
TOT NOS	73657.8	100070.7	100144.5	125552.4	109414.3	109331.8	121396.1	154044.1	147366.6	108183.1	91128.7	140169.7
SPWN NOS	26585.8	30798.6	37558.1	44675.9	44808.1	45267.5	45947.2	51480.1	61673.0	64019.2	54815.3	44809.4
3+ NOS	40570.4	54122.2	72238.2	70950.9	83548.1	70627.3	75649.5	86871.2	114333.4	89677.8	68555.6	58401.0
4+ NOS	26525.7	27154.7	35578.2	48864.7	40697.0	49920.4	44211.2	49641.5	59404.8	73050.6	61892.6	40545.8
5+ NOS	16216.7	16217.6	15369.9	20963.8	25192.9	22340.5	29033.5	25757.2	30480.9	36648.4	44365.2	35892.1

AGE	1982	1983	1984	1985	1986
2	34006.4	12675.6	15865.1	8866.7	38600.0
3	66416.8	27660.2	10310.2	12945.1	7059.0
4	12179.5	50249.8	20314.0	7313.5	8514.1
5	2635.7	7909.4	30866.8	11943.4	3531.5
6	5522.9	1389.4	4758.3	16381.1	4712.3
7	6107.2	2190.2	747.4	2830.1	6463.2
8	2815.1	2665.0	992.6	431.4	1116.6
9	2057.1	1108.0	1262.6	484.0	170.2
10	645.7	938.1	416.6	707.0	190.9
11+	468.2	447.3	216.6	633.4	528.8
TOT NOS	132854.8	107233.1	85750.3	62535.7	70886.8
SPWN NOS	45531.9	55094.3	51057.5	39682.2	24882.8
3+ NOS	98848.3	94557.5	69885.1	53669.0	32286.8
4+ NOS	32431.5	66897.3	59575.0	40723.8	25227.7
5+ NOS	20252.0	16647.5	39260.9	33410.3	16713.7

Table IV.2.9. Estimates of stock biomass (metric tons) derived from virtual population analysis (VPA) of Gulf of Maine - Georges Bank - Scotian Shelf pollock.

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
						STOCK BIOMASS AT AGE						
2	32094.8	70760.7	27906.3	45319.3	21468.9	33285.9	28820.4	53738.3	14204.3	6208.9	12640.9	50696.6
3	23314.2	57710.5	64155.0	30037.2	61277.1	26919.0	39297.8	42441.9	31309.3	30355.0	9194.9	26068.6
4	25669.4	21436.7	55774.9	53011.7	30543.1	56538.8	29444.8	39170.2	43675.1	54603.4	33827.9	11168.8
5	24196.9	18970.8	28552.3	33550.2	41862.6	29604.6	47648.7	25563.8	42743.6	52691.0	59246.8	32441.6
6	18965.0	15893.7	17436.5	14048.4	21818.8	31267.8	19950.2	33686.5	22229.5	35572.9	41240.4	43124.1
7	11291.6	12717.4	11531.2	8759.8	10645.8	15596.7	19446.4	13914.1	23525.8	15317.9	25985.0	28098.1
8	6700.2	6038.1	10398.4	7205.5	6771.4	7048.7	8666.9	11263.6	9017.0	14024.4	10868.1	20812.3
9	5737.7	2600.1	3911.1	7544.3	4759.9	3744.7	3332.7	6025.0	6633.2	5125.5	9581.6	7434.6
10	3805.6	3535.8	2540.2	2048.7	5062.4	2545.2	1951.0	2164.6	3697.3	3395.5	3697.0	6663.7
11+	1961.3	6097.7	1952.8	2829.5	10145.5	2281.2	1711.6	1467.5	2752.5	1567.8	1351.6	1558.5
TO BIOMASS	153736.7	215761.5	224158.8	204354.5	214355.5	208832.7	200270.5	229435.5	199787.6	218862.1	207634.4	228066.9
SP BIOMASS	92432.2	93857.4	124827.4	114257.9	130494.9	131565.1	125459.7	127661.4	140517.8	162390.0	167305.5	150421.6
3+ BIOMASS	121641.9	145000.8	196252.5	159035.3	192886.6	175546.8	171450.2	175697.2	185583.3	212653.2	194993.5	177370.3
4+ BIOMASS	98327.7	87290.3	132097.4	128998.1	131609.6	148627.9	132152.4	133255.3	154274.0	182298.3	185798.5	151301.7
5+ BIOMASS	72658.3	65853.6	76322.5	75986.4	101066.5	92089.1	102707.6	94085.1	110598.9	127694.9	151970.6	140132.9

AGE	1982	1983	1984	1985	1986
2	21084.0	9886.9	16658.4	6561.4	28564.0
3	75715.2	32915.7	13403.2	13462.9	7341.4
4	31301.4	87937.1	43268.9	14188.2	16517.3
5	9251.4	23886.4	80562.5	33083.1	9782.3
6	22864.8	5766.1	16463.9	53402.4	15362.1
7	27665.6	10732.1	3841.4	10697.9	24431.0
8	14892.1	13964.8	5677.6	2238.8	5795.4
9	12939.3	6725.5	7411.5	3087.7	1085.8
10	4726.9	6172.8	2720.6	4482.4	1210.6
11+	3726.6	3453.2	1613.4	4965.5	4146.2
TO BIOMASS	224167.2	201440.7	191621.4	146170.4	114236.0
SP BIOMASS	134119.3	132145.7	138392.1	118966.8	73685.6
3+ BIOMASS	203083.3	191553.8	174963.0	139609.0	85672.0
4+ BIOMASS	127368.1	158638.1	161559.8	126146.1	78330.6
5+ BIOMASS	96066.7	70701.0	118290.9	111957.8	61813.3

Table IV.2.10. Stock biomass and catch projections for 1986 and 1987 for Gulf of Maine - Georges Bank - Scotian Shelf pollock

	1985	1986	1987
F	0.73	0.73	0.73
Catch	60,740	36,519	28,820
3+ Stock	138,902	83,452	81,093
F	0.73	0.93	1.03
Catch	60,740	43,120	34,567
3+ Stock	138,902	83,452	73,615
F	0.73	0.53	0.33
Catch	60,740	28,695	17,247
3+ Stock	138,902	83,452	89,989

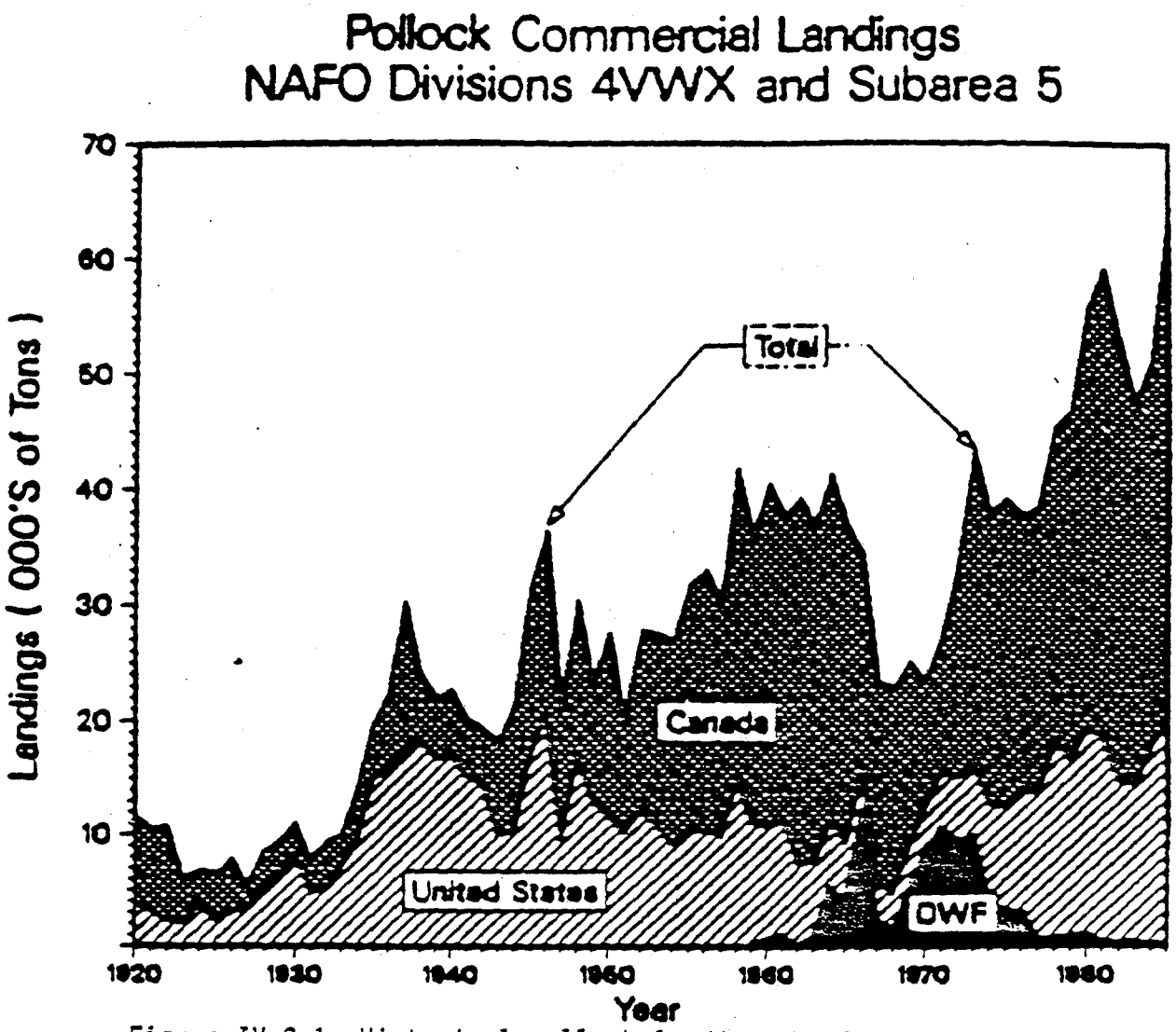
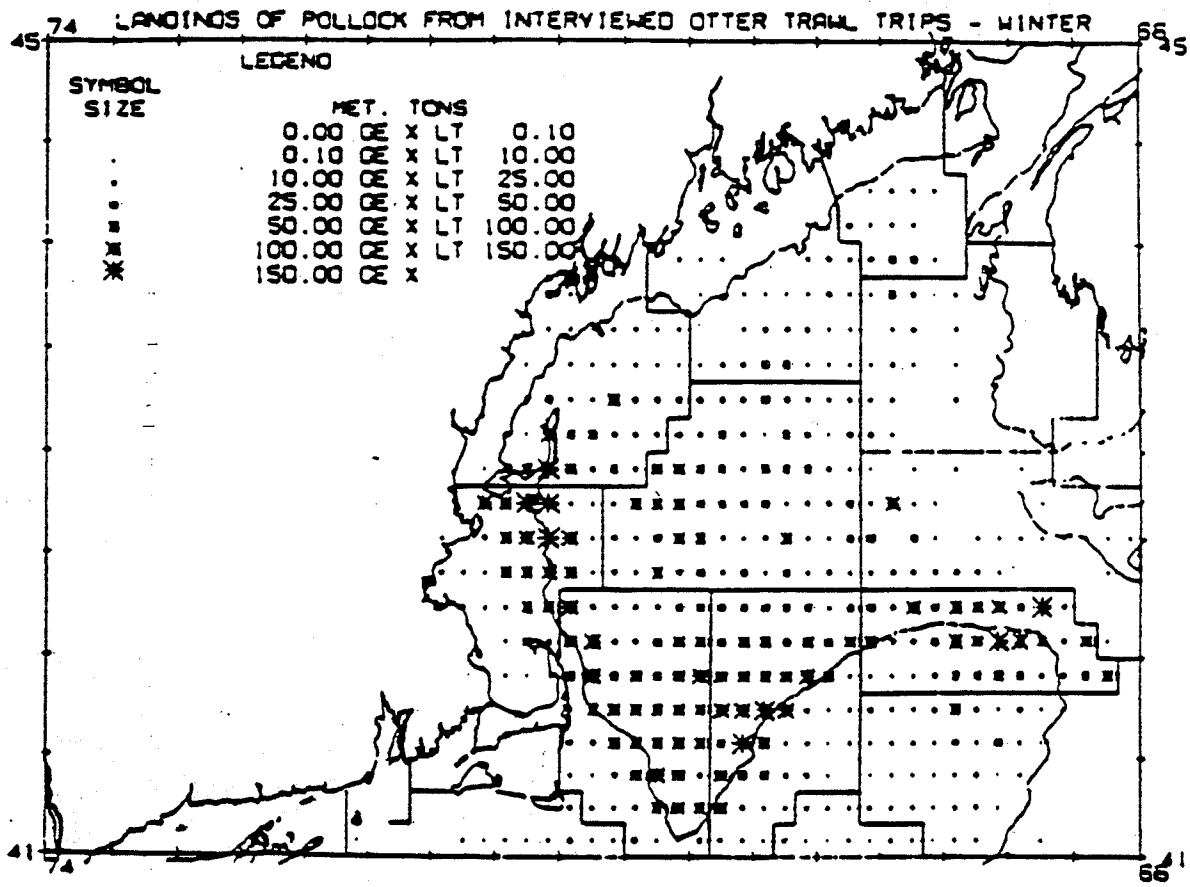
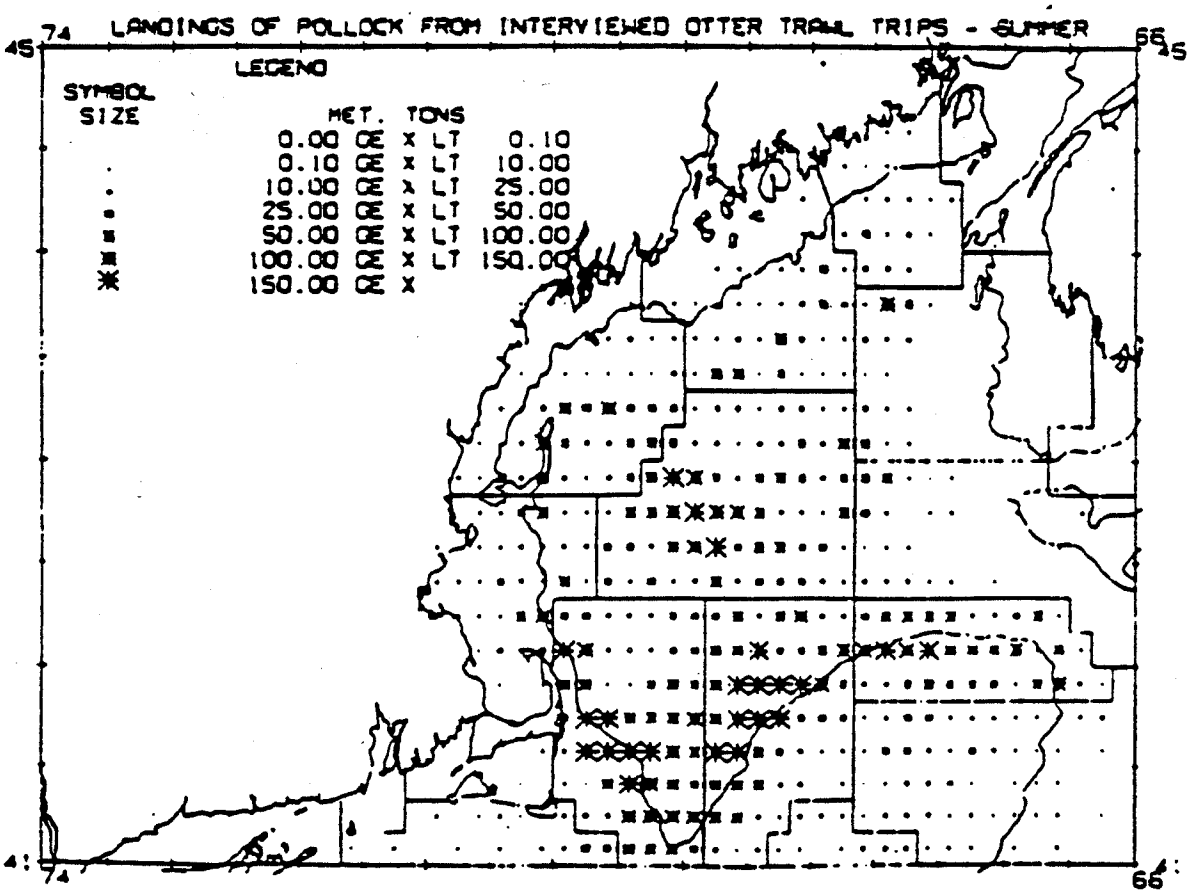


Figure IV.2.1 Historical pollock landings by Canada, United States and Distant Water Fleets (DWF) from NAFO Divisions 4 VWX and Subarea 5, 1920 - 1985.





Figures IV.2.2 and IV.2.3 Spatial distribution of United States pollock landings by season.

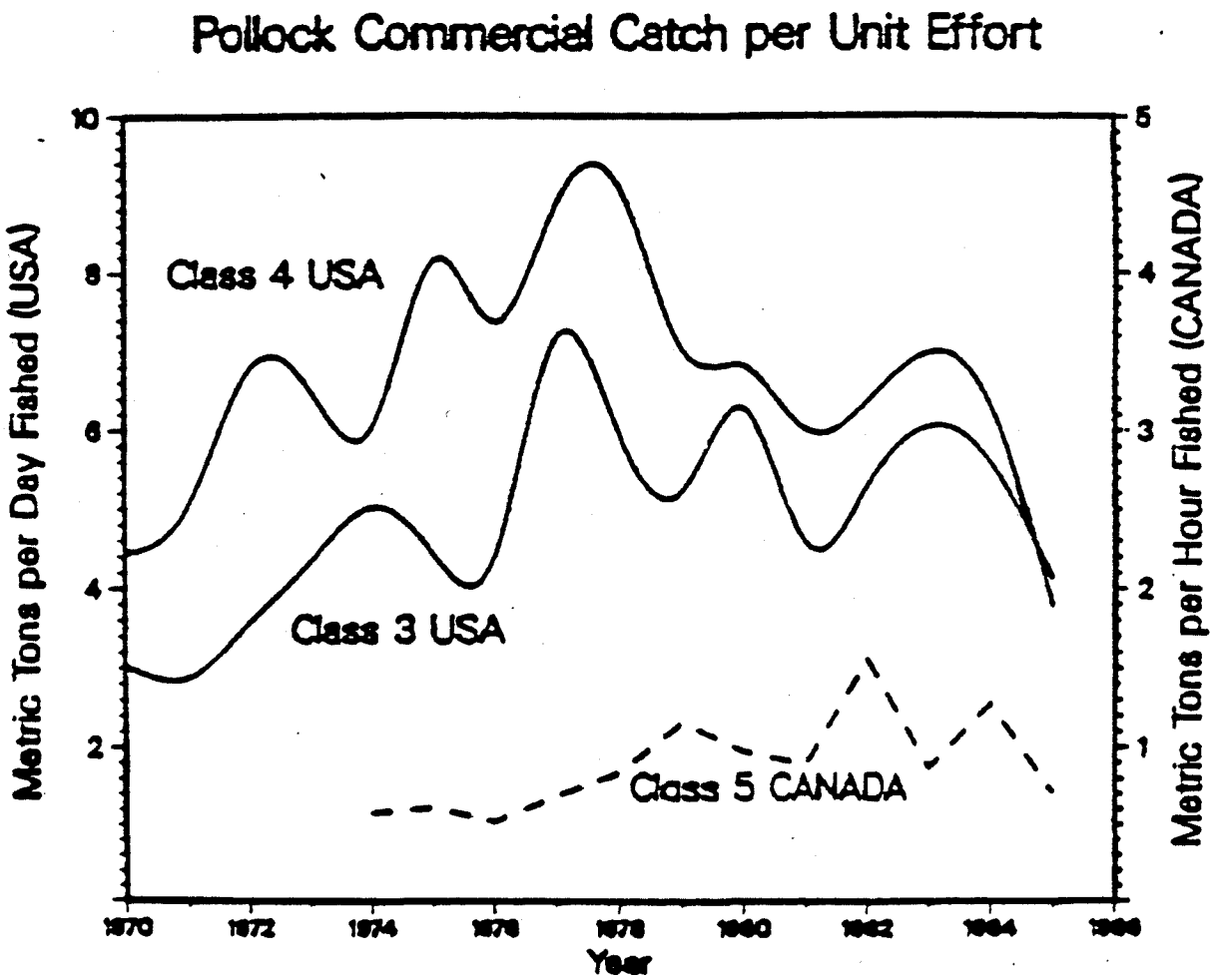


Figure IV.2.4 Canadian and United States commercial catch per unit effort indices for pollock.

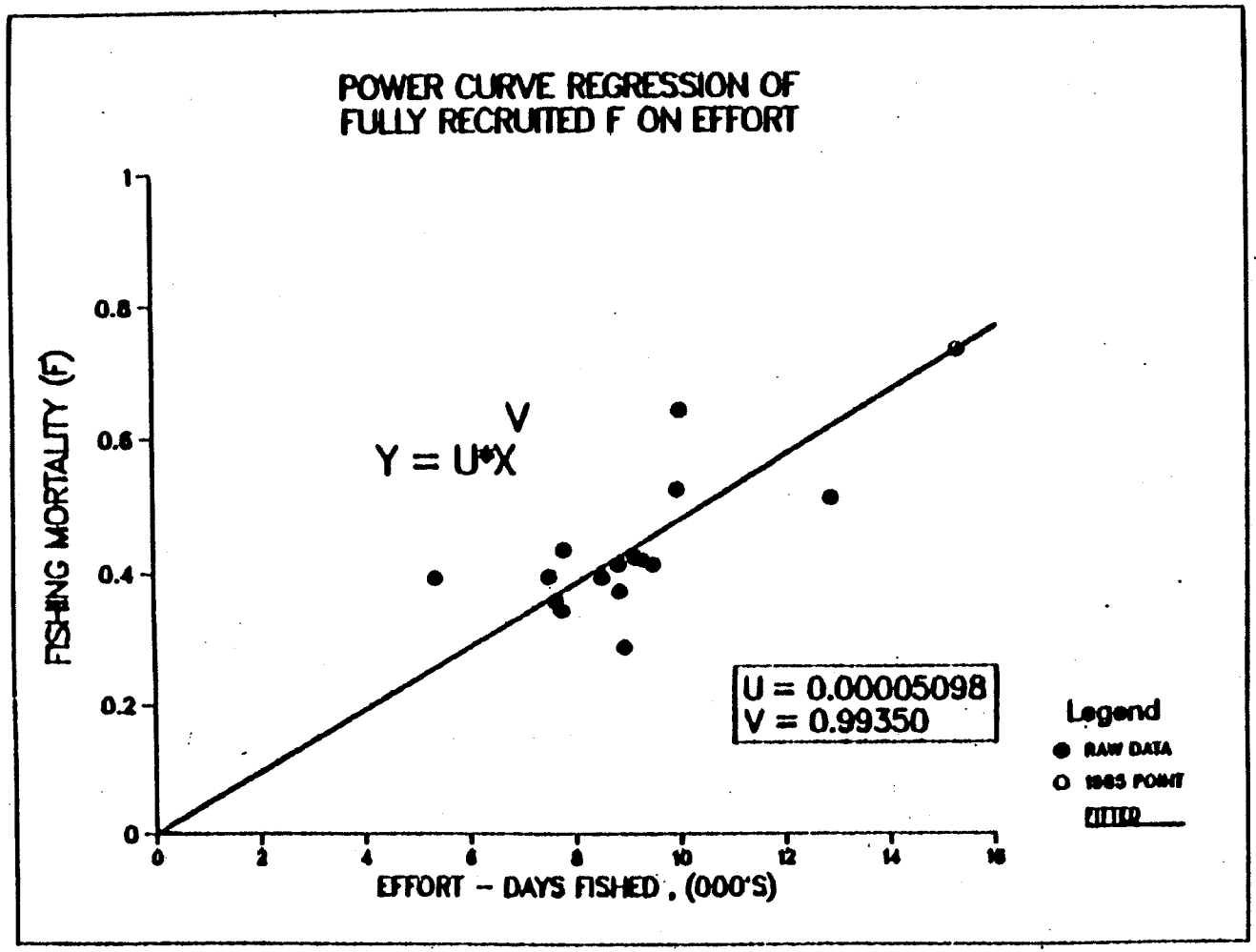


Figure IV.2.5 Regression of fully recruited (age 5+) instantaneous fishing mortality (F) from final VPA on fishing effort from 1970-1984

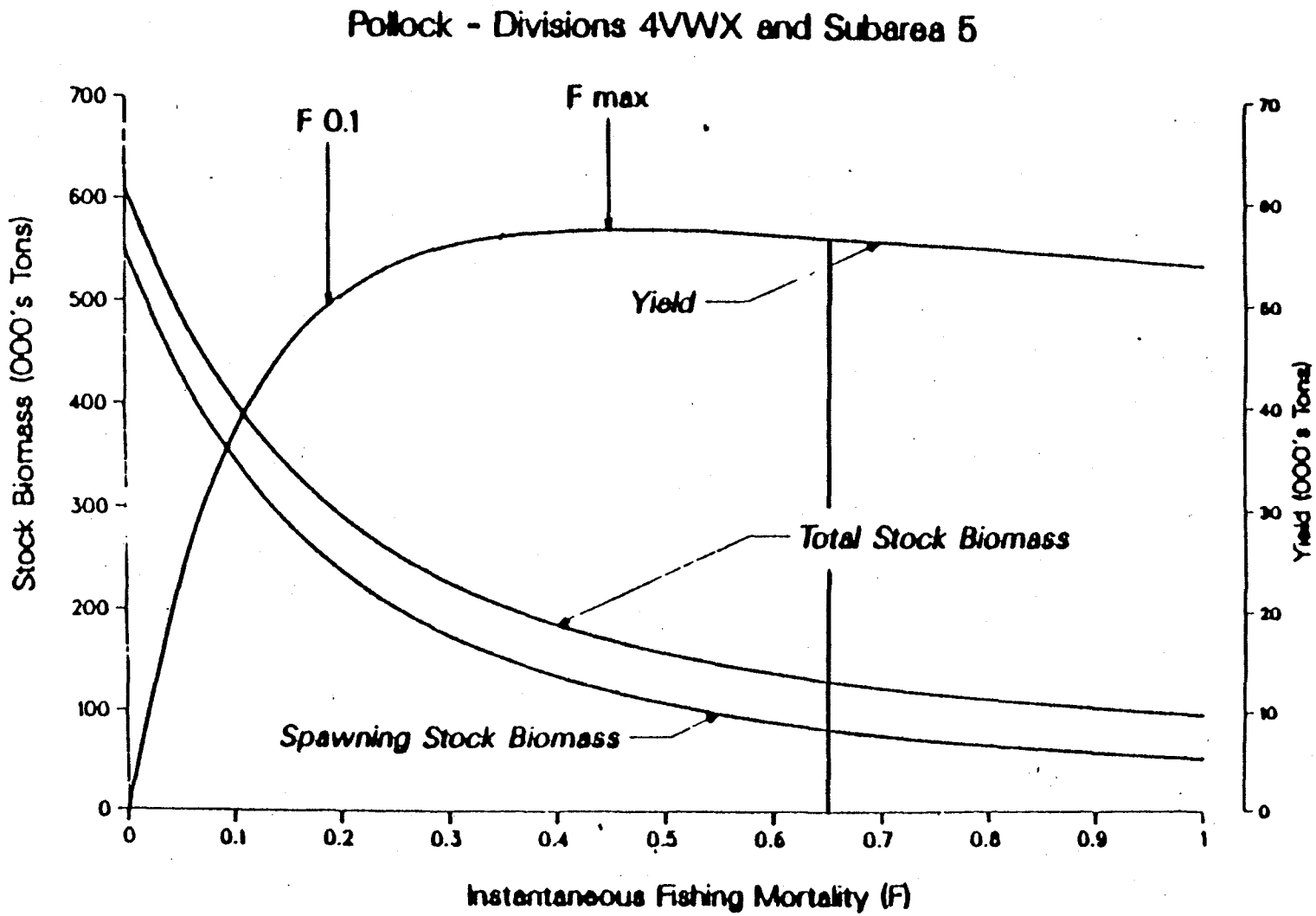


Figure IV.2.6 Equilibrium yield and stock biomass projections for pollock in NAFO Divisions 4VWX and Subarea 5.

3. GEORGES BANK WINTER FLOUNDER

Source Document: Gabriel, W. L. and K. L. Foster. 1986. Preliminary Assessment of Winter Flounder (*Pseudopleuronectes americanus* Walbaum) on Georges Bank. NMFS, NEFC, Woods Hole Lab. Ref. Doc. IN REVIEW 1986. 31 p.

Summary: Commercial landings of 2150 mt in 1985 are 45% lower than 1983-1984 levels, and 40% lower than the 1979-1984 average. Recent effort has reached record high levels. Commercial catch per unit effort indices show a rapid decline from the 1981 peak to historical low levels in 1984-1985. Size composition of the catch has shifted toward smaller fish after 1982. Although aggregate research vessel suvey indices show no clear trend, some disaggregate indices show drops in 1985 and 1986. The stock is likely to be overexploited, based on these indicators.

Discussion: NEFC trawl survey data will be examined for day/night differences to determine if any clear trends can be discerned.

Relationships between CPUE indices and survey abundance were poor ($r = 0.4$, $\alpha = .15$ in the best case), despite fine tuning.

Questions on mesh size and selectivity were addressed. Current mesh size is the same as that used in the cod and haddock fisheries. It was noted that although mesh selection studies on winter flounder were conducted, their applicability to commercial fishing were questioned (e.g. because of time of tow and density differences). The new minimum size (12", 30.5 cm) should reduce landings in the "peewee" market category, which included fish less than 30 cm (about age 2, less than 60% mature). A 5.5" mesh will retain fish below the minimum legal size, since the 50% selection size is about the minimum size. Thus, many immature fish will be removed from the population due to discard mortality.

The consensus of the group was that despite the limited data, it appears the data are consistent with data for other offshore groundfish stocks that are declining due to high levels of fishing effort and low recruitment.

4. NORTHERN SHRIMP

Source Document: Northern Shrimp Technical Committee. MS 1985. Gulf of Maine Northern Shrimp Stock Status - 1985. Report to Northern Shrimp Section of ASMFC, November, 1985, 19 p.

Commercial Fishery Trends: Landings of Gulf of Maine northern shrimp have fluctuated considerably. Annual landings declined from an average of 11,400 metric tons (t) during 1969-1972 to about 400 t in the late 1970's but have since increased to 3,600 t in 1985; the projected total for 1986 is 4,600 t (Table IV.4.1). The collapse of the fishery in the mid-1970's has been attributed to intensive exploitation combined with adverse environmental conditions.

The fishery has been conducted primarily in inshore waters in winter and spring. Maine vessels, fishing primarily between Portland and Pemaquid Point, have accounted for most of the catch, although since 1969 landings by Massachusetts vessels have also been significant. Effort by New Hampshire vessels has increased considerably since the late 1970's. The fishery has been conducted almost exclusively by otter trawling, although pots have also been used successfully along the central Maine coast.

Effort and Catch per Unit Effort: Commercial effort in terms of number of trips has increased from 400 or so trips in 1979 to over 8,000 during the 1984 - 1985 season. Most vessels are "day-trippers" although some larger vessels from Gloucester and Portland are now making more extended trips further offshore. Approximately 300 vessels are known to have participated in the fishery in 1985.

Commercial catch-per-unit effort (CPUE) indices have been developed from trip data for which 50% or more of the total catch consisted of shrimp. Both "annual" and "winter" (February - March) indices have been calculated; the latter appear more reliable from a historical perspective due to shifts in exploitation patterns by area and season.

Both indices declined to minimal levels in the late 1970's but have since fluctuated without a definite trend in spite of ancillary evidence from both the commercial fishery and research vessel surveys indicating a pronounced increase in abundance in recent years. It is unclear whether this inconsistency is related to computational methods or to local population differences.

Size Composition of Landings: Commercial landings are sampled regularly by biologists from the participating states, supplemented as necessary by NEFC port agents. As a rule Maine landings have been composed of larger individuals (age 3+) refecting a direction of effort towards ovigerous females migrating into inshore areas in wintertime. Massachusetts vessels have tended to fish somewhat further offshore thus taking a higher proportion of smaller male (and juvenile) shrimp. A tendency for increased harvests of smaller shrimp is also evident in warmer months as effort is redirected further offshore. An

offshore summer fishery initiated by Massachusetts vessels in 1969 took significant amounts of juvenile shrimp with apparent effects on subsequent recruitment to the inshore winter fishery.

Research Vessel Surveys: Indices of abundance have been developed for this stock from NEFC spring and autumn bottom trawl survey data and data collected in State of Maine summer surveys. Results indicate a decline in abundance from the late 1960's to the late 1970's; for subsequent years index values, particularly for autumn, have increased somewhat although considerable variability is evident.

Survey efforts for this stock were substantially expanded in 1983 by implementation of a stratified random survey directed specifically towards northern shrimp. Results for 1983-1985 indicate a continued increase in abundance and biomass associated with recruitment and growth of the 1982 year class. Index values for 1986 are comparable to 1985 values (Table IV.4.2). Subsequent (1983, 1984) year classes appear weaker; but the 1982 year class is expected to contribute substantially to the upcoming winter fishery based on 1986 survey results. Thus, prospects for the immediate future appear good.

Summary: Recent assessment results indicate that the Gulf of Maine northern shrimp resource continues to recover from the very low levels of abundance of the late 1970's. Commercial landings have increased substantially in recent years, apparently reflecting the trend of increased abundance documented by research vessel survey data. Mortality rates calculated from research vessel survey data have been low in spite of a substantial increase in commercial effort. There is no evidence at present that current levels of exploitation or environmental conditions are adversely affecting this stock.

Discussion: Historical catch and effort data for the Gulf of Maine northern shrimp stock was presented. NEFC bottom trawl survey data were examined for their usefulness in tracking northern shrimp abundance. The group generally agreed that of the NEFC surveys, autumn survey results were most useful for this purpose. The August Shrimp Survey initiated by the Technical Committee in 1983 appears to provide the most reliable survey data source for this stock.

The recent increasing trend in population size is associated primarily with recruitment and growth of the strong 1982 year class. It was pointed out that a significant proportion of this year class had not completed transition in 1985 i.e., many of these shrimp were still males at age 3+. It was suggested that this phenomenon may relate to changes in population density or environmental factors as has been observed for other sequential hermaphroditic species.

Results of the Gulf of Maine August Survey suggest an increase in abundance and biomass from 1983 - 1985; 1986 indices are comparable to 1985 values. Comparisons of recent harvest levels with minimum biomass estimates developed from swept area calculations suggest that exploitation rates in recent years have been relatively low. The outlook for the coming season appears to be good although prospects for subsequent years are more problematical given that more recent year classes appear to be weaker.

The group expressed concern that by-catch of juvenile fish in the shrimp fishery may pose a serious threat to Gulf of Maine finfish stocks. It was noted that current information relative to this source of mortality is limited and that much more information is needed.

Table IV.4.1 Commercial landings (metric tons) of northern shrimp in the western Gulf of Maine by state, 1980-1986.

Year	State: Maine		New Hampshire		Massachusetts		Totals	
1980	69.5		5.4		256.9		331.8	
1981	528.6		4.5		538.1		1,071.2	
1982	883.2	(853.3)[1]	32.8	(22.3)	658.5	(655.3)	1,574.0	(1,530.9)
1983	1,029.0	(892.5)	36.5	(46.2)	508.0	(460.1)	1,573.5	(1,398.8)
1984	2,564.7	(2,394.9)	96.8	(30.7)	565.3	(525.1)	3,226.8	(2,950.7)
1985	2,956.9	(2,946.4)	207.4	(216.5)	1,030.6	(968.0)	4,194.9	(4,130.9)
1986[2]	-	(3,269.5)		(214.9)		(1,136.7)	4,600.0	(4,621.1)

[1] Seasonal totals, e.g., 1983 includes December 1982 but does not include December 1983.

[2] Preliminary.

Table IV.4.2 Summary of northern shrimp survey cruise results in the western Gulf of Maine aboard R/V GLORIA MICHELLE, 1984-1986.

Year	Stratified Mean Catch per Tow[1] No. (000'S)	Wt. (Kg)	Var (No)	Var (Wt)
1984	3.00	22.62	0.19	9.83
1985	3.53	29.39	0.20	13.25
1986	3.36	30.13	0.27	14.61

[1] Strata 1, 3, 5, 6, 7, and 8.

1. WORKING GROUP 5: Scientific value of experimentally manipulating fishing mortality on mackerel or other lightly exploited species.

TERMS OF REFERENCE:

This group was established during the 2nd SAW to develop a working paper on the scientific value of such experiments, as described in the Report of the 2nd SAW (Woods Hole Lab. Ref. Doc. 86-9). A concept paper is expected at the fall workshop. Bill Overholtz and Steve Murawski will act as co-chairs, and other participants include Tim Smith and Brian Rothschild.

REPORT:

Bill Overholtz reported that he had completed some analyses of the mean weight at age of mackerel, suggesting that density dependent growth effects were apparent as the mackerel population has been increasing. Additionally, he had begun developing a simulation model to explore the effect of different fishing mortality scenarios that might be useful for this project. He anticipated that the group would be more active over the winter, and that while the focus of the working group was still developing, more activity would occur this winter. It was noted that the terms of reference for such working groups need to be quite specific to insure that the workshop obtains the information that it is seeking.

2. WORKING GROUP 6: Trawl Survey design.

TERMS OF REFERENCE:

This group was established during the second SAW to develop a working paper on the theoretical basis and operational and technical limitations of trawl surveys. Brian Rothschild and Mike Fogarty will act as co-chairs, and participants include Tom Hoff, Mike Pennington, Steve Clark, Vic Crecco and Sukwoo Chang.

REPORT:

Analyses have been performed to evaluate the accuracy and precision of the relative abundance indices estimated from trawl survey data sets. Variability in trawl abundance estimates was evaluated by the statistical analysis of non-zero catches as partitioned by season, ecological subgrouping and species. Autoregressive moving average techniques were employed to detect trends in historical times series data. The final portion of the presentation was an overview of trawl survey performance in comparison to other relative abundance data sources.

3. WORKING GROUP 7: Analysis of changes in catchability with changes in stock abundance.

TERMS OF REFERENCE:

This group was established during the 2nd SAW to explore the possibility of detecting changes in catchability by comparing survey indices and virtual population analysis. Population size estimates will be explored by analysis of suitable data sets from NEFC. Vic Crecco will take a lead, and NEFC staff will provide data; other participants were not identified.

REPORT:

Vic Crecco noted that there was some discussion about what species would be suitable, and that haddock had been suggested as having the needed catch, effort, and independent stock abundance information. Definition of fishing effort needed to be resolved, however. He anticipated that some progress could be made by the next meeting.

4. WORKING GROUP 8: Bluefish ageing research needs.

TERMS OF REFERENCE:

Review accuracy of current methods of estimating age of bluefish, test among-reader variability, and establish research needs and priorities. Prepare a brief report of results for review by 3rd SAW on Friday.

REPORT:

The Group met Tuesday and Wednesday to review previous and current bluefish ageing work and to plan cooperative approaches for addressing assessment-related needs. Participants included personnel from state agencies of New Hampshire, Connecticut, New York, North Carolina, NEFC and the ASMFC. The meeting was precipitated by the need for adequate data for use in developing the current version of the bluefish plan.

Bluefish age and growth studies have been few. The most extensive (reported in Wilk 1977) was based on some 25,000 samples collected during the mid-to-late 1960's. Limited information is also available from other sources (e.g., Backus 1962, Richards 1976). Growth curves fitted to these and more recent data (attached) and other sources of information suggest that growth rates have changed in recent years. It is therefore necessary to evaluate recent data in more detail and to supplement it as needed to provide an adequate data base for future assessments.

The Group reviewed current data collection and ageing activities. These can be summarized as follows:

Agency	Data Source	Time Frame	No. Collected	No. Aged
N.H.F&G	Recreational	1984+	< 100	< 100
Conn. DEP	Survey	1983+	> 600	> 600
N.C. DEM	Commercial	1982+	>1500	>1500
SUNY	Recreational	1986	> 300	> 300
NEFC	Survey	1978+	>2400	< 400 (preliminary)
Woods Hole	Commercial	1982+	>1400	-
Sandy Hook	Recreational	1985	4000	-

Thus, between 2,500-3,000 age determinations, together with some back-calculation work, are available for comparative purposes. The 1985 Sandy Hook material was collected during an extensive sampling program covering most of the Atlantic coast.

Age determinations by Connecticut and North Carolina will be summarized and analyzed by the ASMFC S&S Committee; additional ageing requirements will be noted and addressed by the present group. The following responsibilities were agreed to:

1) Additional material will be aged by working group participants from North Carolina, Connecticut, SUNY, and New Hampshire (each organization will be responsible for ageing 200-300 samples). NEFC (Sandy Hook) personnel will assist with ageing older fish. It was agreed that 1985 samples now archived at Sandy Hook would provide an excellent source of material for this purpose. Samples will be exchanged so as to insure two readings. It is believed that this effort, along with current work described above, will provide the necessary data base needed.

2) NEFC staff will assist with defining the subsample to be used and will be responsible for sample preparation (scale impressions).

3) The Group will meet following completion of this work (probably Spring 1987) to review and summarize results.

To insure that results would be comparable the Group performed comparative ageing work on a sample of 20 bluefish scales. Agreement was reasonably good (80%) between the five primary readers involved. Agreement was also reasonably good on a selected sample of older fish. The Group concluded that differences in interpretation should not pose a major problem in future cooperative work. The need to document between different spawning groups (large distance from focus to first annulus, spawned in spring vs. small distance from focus to first annulus, spawned in autumn) was also noted and it was agreed that measurements would be made diagonally from the longitudinal axis of the scale. It was also agreed that a January 1 birthdate would be used as a convention.

5. WORKING GROUP 9: Methods of measuring long-term potential catch.

TERMS OF REFERENCE:

The working group will review the classic definition of maximum sustainable yield (MSY) as well as the qualifications associated with that definition. The working group will then consider alternatives to that definition and specify how these alternatives provide advice on either maximum yield, sustainable yield, or the desired combination of the two. The working group will review existing FMP to determine how this problem has been handled under the FCMA. Finally the working group will make recommendations on future research, pointing as well to any constraints in implementation that might be evident. Workshop participants would like a report during the next Workshop. Working group participants include Brian Rothschild (Chair), Ray Conser, Tom Hoff, Vaughn Anthony, and Howard Russell. The Workshop Chairman was asked to communicate with those not present during this portion of the discussion.

6. WORKING GROUP 10: Differences in catches of summer flounder reported in official U.S. statistics and used in assessment analyses.

TERMS OF REFERENCE:

Identify differences between U.S. official catches of summer flounder and those represented in NEFC computer files. Prepare a report documenting these differences, with recommendations as to importance and remedies. Participants are Anne Richards (Chair), Tom Hoff, Darryl Christensen and Mike Fogarty.

1. METHODS OF MEASURING LONG TERM POTENTIAL

To respond to the second management term of reference, the Workshop participants discussed the requirement under the FCMA that management be based on the concept of optimum yield as derived from an estimate of maximum sustainable yield. Numerous problems were identified with the implementation of this requirement, both from a scientific perspective and from a management perspective.

The lack of a definition of maximum sustainable yield (MSY) in the FCMA was noted, although the legislative history of the law was thought to imply that the reference was to the now classical definition given by Schaefer (1957). Several difficulties were noted about that definition in that it was based on a very specific mathematical model of density dependent population growth that did not explicitly display specifics of the fishery or of the age distribution of the population. It was argued that with sufficient information about the internal processes of the fishery and of the population, especially about regulatory processes and interacting species, a more complete definition based in the same principles that Schaefer offered was obvious.

The problem was not seen as the concept, but rather the difficulty and, at current levels of information for most species, the impossibility of adequately dealing with all of the factors involved. In practice it was noted several approaches have been used in determining catch levels to be used in management plans under the FCMA to meet the maximum sustainable yield requirement. Indeed, guidelines published by NMFS for implementing management plans note the potential for difficulty with this requirement because of lack of information, and suggested situations when specifying a value may not be desirable (NMFS, Federal Register, 48 FR 7402).

The most obvious method of determining a value to meet the requirement of the FCMA is based on that used by Schaefer for fitting the parameters of the logistic equation. Specifically this involves relating the catch per unit of effort to cumulative effort in one form or another. This approach has several difficulties, including being bound by the portion of the range of the stock that is fished, possible changes in the implicit ecological relationships that are not explicitly identified, and statistical problems in estimating equilibrium conditions from non-equilibrium data. However, it was noted that it has been widely used in other areas of the country.

A second method that has been used is based on selecting specific fishing mortality rates from biological reference points based on equilibrium or cohort yield per recruit models. These biological reference points are directly related to levels of spawning stock biomass per recruitment (SSB/R). The inverse of these points provide a series of straight lines which pass through spawning stock and recruitment data and intersect with a SSB/R equilibrium curve. This analysis, in turn, provides an estimate of SSB to which the current SSB should be rebuilt to achieve MSY and an estimate of R which when multiplied by the appropriate Y/R value provides an estimate of MSY. This can be termed a "realistic" estimate of MSY since it is based on current assumptions associated with the development of yield per recruit curves.

Levels of catch corresponding to the selected reference points and estimated average observed levels of recruitment have been used to meet the requirements of the FCMA. Examples of this approach are the values given in the Source Document for bluefish at this meeting and the current management plan for redfish in the Gulf of Mexico. It was noted that the required information for this approach is frequently available.

A third approach was suggested of defining a level of fishing that would allow sufficient accumulation of stocks over a range of ages to smooth out the year to year fluctuations in catches. Such levels might be calculated from growth and mortality rates in conjunction with the observed frequency of strong year classes.

A fourth approach is to use the average catch over a period of years, although the values obtained are clearly dependent on the specific methods of the fishery during those years, and have no assurance of being maximal.

It was noted that even if a consistent definition of the concept can be used for all species, the nature of the available data will determine in large measure the approaches that can be used, and as additional data are obtained the estimates can be assured of changing. Similarly, as the fisheries change and as environmental conditions change the available data for determining maximum sustainable yield as required under the FCMA will change.

For example, the original work by Schaefer (1957) resulted in an estimate of maximum sustainable yield of 80,000 tons of yellowfin tuna, while the current estimates are in the range of 180,000 tons. The evolution of estimates of maximum sustainable yield as data increase and as the fishery changes must be contended with in management actions.

It was suggested that neither the Fishery Management Councils nor the NMFS is in a good position to develop methods of determining maximum sustainable yield for the purposes of developing fishery management plans because of the range of possible approaches and because the best approach of measuring this quantity may depend on the specific management measures being taken. It was suggested that future meetings of workshops like the present one, involving a wide range of scientific expertise and perspectives, may be suitable for jointly developing values for use in management plans.

Such undertaking would necessarily involve considerable advance preparation of material, and could be rather demanding in the context of reviewing the status of several other stocks as is currently done. Additionally, specific conceptual and methodological guidelines would be useful. It was suggested that a working group might develop such guidelines over the next few months, perhaps elaborating a conceptual basis and documenting how this requirement is being met in the fishery management plans currently in place nationwide.

2. DISCUSSION OF TERMS OF REFERENCE FOR FUTURE WORKSHOPS

Terms of reference and timing of subsequent stock assessment workshops were discussed, based in part on discussions during the 1st and 2nd Workshops. Holding such workshops twice a year was agreed to be sufficient to meet the scientific and management needs as presently understood. The timing of the present meeting was useful to meet needs of the Mid-Atlantic Fisheries Management Council for their quota managed species, although previous communication from Massachusetts indicated that the timing of their fall survey work limited their participation. The timing of the 2nd SAW in early May was agreed to have conflicted with field programs. Timing of annual catch and survey data availability was discussed, and certain constraints noted.

The amount of time required for reviewing assessments was noted as varying, with presentations of updates of previous assessments requiring less time, and with presentation of revisions of previous assessments requiring more time. However, it was noted that some of the assessments reviewed in the present workshop were presented in more depth than required given that the documents were available to the participants. Making documents available further in advance was noted as being desirable when possible.

The importance of focusing the attention of the Workshop participants on more generic topics and problems was emphasized. Terms of reference were developed with the goal of reducing species-specific discussions to the minimum needed in order to maximize time for such discussion.

Methods of generating terms of reference were discussed. The distinction between scientific and management terms of reference was noted, as indicated in the terms of reference for the present meeting. The Workshop participants felt able to offer scientific terms of reference, and representatives from the Mid-Atlantic Fishery Management Council indicated that they could reflect management information needs that had been identified by that group. It was suggested that the terms of reference that the present group might develop be circulated to the two fishery management councils and to ASMFC for comment, although concern was expressed that reasonable priorities that reflect available time and scientific possibilities may be difficult to develop where that input comes separate from the Workshop itself.

The list of species discussed during the 2nd SAW was reviewed as follows:

Haddock: Nothing needed for Gulf of Maine stocks as no changes in status anticipated. Update needed only of strength of 1985 yearclass for Georges Bank stock as no changes in status are anticipated.

Redfish: Nothing needed as no changes in status anticipated.

Red hake: Update needed as increased fishing pressure possible.

Silver hake: Revised assessment needed, and anticipated to be available for 4th SAW.

Yellowtail flounder: Revised assessment with VPA needed, but not anticipated to be available for 4th SAW.

White hake: Nothing needed now; update alternate years probably sufficient.

Sea scallops: Update needed.

Witch flounder, American plaice: Update as group needed because of shift of effort towards these stocks anticipated to be continuing, and windowpane flounder should also be considered.

Atlantic mackerel: Update needed.

Butterfish: Update needed.

Long-finned squid: Update needed.

Short-finned squid: Update needed.

The species reviewed in the present meeting were also discussed, and the following priorities noted:

Surf clams and Ocean quahogs: Density dependent growth and long term sustainable catches need to be addressed, probably one year from now.

Summer flounder: Additional assessment work is needed, and will likely be available for the 4th SAW.

Bluefish: The ASMFC Bluefish Committee would appreciate additional review of its assessment approach at the 4th SAW.

Inshore lobster: Additional work is needed, but development of significant new information uncertain for 4th SAW.

Winter flounder: Major workshop on biological aspects anticipated in December; no additional assessment information likely available in 4th SAW.

Other species which might be profitably discussed during the next Workshop were discussed:

Pelagic sharks: Depends on Council action for determining priority.

Scup: Update on status needed; representatives from Connecticut indicated that they might sponsor that work and NEFC representatives agreed that NEFC data could be made available.

Black sea bass: Assessment work needed, but no significant information likely to be available.

Striped bass: Planned ISFMP workshop noted; representatives requested that 4th SAW review design of monitoring program.

Other possible terms of reference were reviewed, and the following noted as being especially pertinent.

Shellfish gear selectivity and discard mortality: Review results of New England Fishery Management Council gear selectivity experiments, and NEFC submersible research program on discard mortality.

Mixed species fishing effort: Review of adequacy of present methods of measuring commercial fishing effort in mixed species trawl fishery.

Recreational fishery data: Review of problems of survival of released fish, of defining effort for individual species, of assigning catches to statistical areas, of discrepancies between tabled values and length frequencies databases, and of general statistical variability of survey data.

Other topics that were discussed as possible terms of reference included *Illex* availability, butterfish mesh selectivity, habitat importance, discard mortality, and estimates of natural mortality and sensitivities of assessment methods to uncertainties in these values. It was agreed that NEFC would circulate a selected bibliography describing recent work within the International Council for the Exploration of the Sea (ICES) on the problems of discard mortality and on natural mortality in fish stock assessments.

3. RECOMMENDED TERMS OF REFERENCE

Workshop participants recommended that another Workshop be held March 30 through April 3 at NEFC in Woods Hole with the following Terms of Reference.

1. Review revised assessments of silver hake, and summer flounder.

2. Review updates of status of (1) Georges Bank 1985 haddock yearclass, (2) red hake, (3) sea scallops, (4) witch flounder, (5) American plaice, (6) windowpane flounder, (7) Atlantic mackerel, (8) butterfish, (9) long-finned squid, (10) short-finned squid, (11) scup.

3. Review methods being used for bluefish assessment, and the design of the striped bass monitoring program.

4. Review shellfish gear selectivity and discard mortality studies, especially the New England Fishery Management Council gear selectivity experiments and the NEFC submersible research program on discard mortality.

5. Review of adequacy of present methods of measuring commercial fishing effort in mixed species trawl fishery.

6. Review of problems in recreational survey data, including survival of released fish, of defining effort for individual species, assigning catches to statistical areas, discrepancies between tabled values and length frequencies databases, and general statistical variability of survey data.

Literature Cited

Anderson, E. A. 1980 A preliminary assessment of the status of bluefish (Pomatomus saltatrix) along the Atlantic Coast of the United States. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 80-30, 29 pp.

Backus, R. A. 1962. Age in a small sample of bluefish (Pomatomus saltatirx L.). Breviora 159:1-4.

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Murawski, S. and F. Serchuk. 1983 An assessment of the Ocean Quahog, Artica islandica, resource and fishery in FCZ waters off the Northeastern USA - Autumn 1983. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 83-25, 31 p.

Murawski, S. and M. Fogarty. 1984. A spatial yield model for bivalve populations accounting for density-dependent growth and mortality. ICES C.M. 1984/K:26.

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Nesbit. R. A. 1954. Weakfish migration in relation to conservation. United States Fish and Wildlife Service, Special Scientific Report, Fisheries 115:1-81.

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DRAFT AGENDA FOR 3rd NEFC STOCK ASSESSMENT WORKSHOP

SEPTEMBER 8 TO SEPTEMBER 12

NORTHEAST FISHERIES CENTER
AQUARIUM CONFERENCE ROOM
WOODS HOLE, MASS.

MONDAY - September 8:		Report Section
1300	Introductions, Welcome by Dr. Pearce, Deputy Center Director	
1315	Review of Terms of Reference, Draft Agenda, and Workshop Procedures: Tim Smith, Chair	I
	Review of Mid-Atlantic Fisheries Resources Species Steve Murawski, Chair	II
1330	Revised Surf clam Assessment: Steve Murawski	II.1
1500	Updated Ocean quahog Assessment: Steve Murawski	II.2
	Review of Reports: T. Smith, Chair	
1600	WG 5 - Experimental Mackerel Fishery - Bill Overholtz	V.1
1615	WG 7 - Changes in catchability - Vic Crecco	V.2
1630	Break for Dinner	

TUESDAY - September:

	Review of Coastal and Estuarine Fisheries Resources Species: Paul Perra and Mike Fogarty, Co-Chairs	III
0900	Updated Summer Flounder Assessment: Anne Richards	III.1
1100	Revised offshore Lobster Assessment: Joe Idoine	III.2
1200	Break for lunch	
1330	Discussion of inshore lobster stock assessment research needs: Mike Fogarty	III.2
1430	Discussion of weakfish stock assessment research needs: Gary Shepherd	III.3
	Establishing new Working Groups: T. Smith, Chair	
1530	WG 8- Bluefish ageing research needs: Steve Clark	V.4

THURSDAY - September 11:

Review of New England Fisheries Resources Species (Continued)

0900	Revised Georges Bank Winter flounder Assessment: Wendy Gabriel	IV.3
1000	Updated Northern shrimp Asssessment: Steve Clark	IV.4
	Terms of Reference for 4th SAW: T. Smith, Chair	1.3
1100	Management terms of reference	
1200	Break for lunch	
1330	Scientific Terms of Reference	
	Review of Reports: T. Smith, Chair	
1400	WG 9: Methods of measuring long-term potential catch	V.5
1500	WG-6: Trawl survey design - Mike Fogarty	V.3
1600	Estuarine Winter flounder	III.4
1615	Bluefish	III.5
1630	Atlantic cod	IV.1
1645	Pollock	IV.2
1700	Break for dinner	
1900	Complete Draft Working Group Reports	

FRIDAY - September 12:

Review of Reports: T. Smith, Chair

0900	WG-8: Bluefish ageing research needs - Steve Clark	V.4
0930	Terms of reference for 4th SAW	I.3
1000	Georges Bank winter flounder	IV.3
1015	Northern shrimp	IV.4
1030	Final Review of Workshop Report	
1200	Adjourn	

Tuesday, September 9 Cont.

1600	WG 9 -Methods of estimating long-term potential catch:	V.5
	Review of Reports: T. Smith, Chair	
1630	Surf clams	II.1
1645	Ocean quahogs	II.2
1700	Break for dinner	
1900	Working Groups meet Review assessment documents for Wednesday	

WEDNESDAY - September 10:

Review of Coastal and Estuarine Fisheries Resources (Continued)

0900	Revised Estuarine Winter Flounder Assessment: Karen Foster	III.4
1000	Updated Bluefish Assessment: Mark Terceiro and John Mason	III.5
1200	Break for lunch	
	Review of New England Fisheries Resources Species: Fred Serchuk, Chair	IV
1330	Revised Atlantic Cod Assessment: Fred Serchuk	IV.1
1530	Updated Pollock Assessment: Ralph Mayo	IV.2
	Review of Reports: T. Smith, Chair	
1700	Summer flounder	III.1
1715	Lobsters	III.2
1730	Weakfish	III.3
1745	Social hour, 2nd Floor, Aquarium Building	

2. PARTICIPANTS

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