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Report of the Fourth NEFC Stock Assessment Workshop (Fourth SAW)

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I. INTRODUCTION

1. OVERVIEW

The fourth in a series of stock assessment workshops was held at the Northeast Fishery Center in Woods Hole, Massachusetts from Monday March 30 through Friday April 3, 1987. The workshop had the same general goals as the second and third workshops, as described in the respective reports (NEFC 1986a, p. 1-5, NEFC 1986b, p. 2-3). The reports of these workshops are designed to serve as the best available scientific advice on the status of the stocks for use by the various groups with fishery management responsibilities.

The primary assessment information is found in the source documents identified for each species. Material is presented in this report summarizing the current status of each species based on that source document, bringing the tables up to date if the source document is not current.

The workshops are becoming more important to the generation of stock assessment advice in the Northeast, and some problems are being seen or are being anticipated. The qualifications of the scientific participants may need to be addressed to allow distinction between assessment experts and other people who, because of their specific knowledge and interests, might be of assistance to the workshop for special information. It was agreed to define a list of participants and a list of observers. It was suggested that, while the latter would be allowed to address the group at the discretion of the Chair, the Chair should actively solicit input from the observers during each stock assessment presentation to encourage the development of useful information that may help improve the assessments.

The number of workshop participants was discussed in the sense that the meetings should not be allowed to become too large, and further, that the number might be restricted so that a higher proportion of participants would be able to be present throughout the workshop. The importance of continuity throughout the meeting was stressed so that the report accurately reflects the information presented and, importantly, the discussion of that information. Further, the importance of the participation of scientists working on a variety of species so as to allow improvement in methodology based on a wider experience was stressed.

The question of the use of the information reviewed during the workshop, and especially the summaries included in the workshop report, was discussed. The proposed flow of information described in previous SAW reports (NEFC 1986a, 1986b) suggests that the reports of this workshop could be the primary source of stock assessment information for the Northeast region. It was suggested that it is important that the report include an accurate summary of both the assessment information presented and the discussion that follows. The latter is especially important in revealing the limitations or weaknesses of the assessment information. Such reports then should constitute the "best available scientific information," and should be treated as such by the management agency which needs information. However, it was stressed that a full understanding of the limitations and constraints in the analyses as

reflected in the workshop discussion and in the report is the responsibility of the user.

Two specific circumstances were noted which might result in the SAW report information not being the best available. One circumstance is that, in the course of the workshop, errors may be made that are not detected. All parties have the responsibility of identifying to others the existence of such errors as they are identified, and the user must be aware of this possibility. The second circumstance is when new information become available subsequent to the workshop. If such information is such that may affect the validity of the conclusions of the workshop, then all parties have the responsibility of identifying the information to others, and the user of the assessment information must be aware of the possibilities.

Assessment information has been presented to the workshops at two levels of detail. The first is as complete revisions to, or initial developments of, assessment information on a stock. Information at this level of detail is usually conveyed in formal scientific reports of one form or another, frequently for NEFC staff as Laboratory Reference Documents. The second level of detail is as an update to a previously developed complete assessment. In this case the entire text of the updated assessment can often be included directly in the workshop report. Silver hake and butterfish are examples of each type, a revision and an update.

2. TERMS OF REFERENCE

During the Third Stock Assessment Workshop held at NEFC in September 1986 terms of reference for the present meeting were developed, as described in the meeting report (NEFC 1986b, pages 89-92). Subsequently, additional recommendations have been made, resulting in some additions as well as deletions. Based on these discussions, the terms of reference for the present meeting are:

Management Terms of Reference

1. Review the status of stocks of butterfish, mackerel, long-finned squid, short-finned squid, scup, silver hake, and American plaice, as well as the 1985 haddock year class on Georges Bank.

Scientific Terms of Reference

1. Review methods being used for bluefish assessment.

2. Review the design of the striped bass fishery-independent monitoring program.

3. Review the NEFC shellfish discard mortality study.

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

5. Review problems in use of recreational survey data in assessments.

6. Review development of NEFC Inshore Research Plan

7. Review development of NEFC Mackerel Biomass Estimation from Ichthyioplankton Study.

8. Review reports from SAW Working Groups established previously.

Generation of Stock Assessment Information

1. Develop dates and recommended Terms of Reference for the 5th SAW.

2. Develop preliminary Terms of Reference for subsequent SAWs.

3. Review structure and role of Stock Assessment Workshop for generating stock assessment advice.

4. Review Research and Management Priorities for the Mid-Atlantic Fishery Management Council, the New England Fishery Management Council, the Northeast Regional Office, the several States, and the Northeast Fishery Center.

II. REVIEW OF MID-ATLANTIC FISHERIES RESOURCES

1. BUTTERFISH

Source Document: Waring, G. T. and E. Anderson. 1983. Status of the Northwestern Atlantic butterfish stock - 1983. NMFS, NEFC, Lab. Ref. Doc. No. 83-41, 39p.

Management

Butterfish are managed under the provisions of the Fishery Management Plan (FMP) for the Atlantic Mackerel, Squid and Butterfish Fisheries, developed by the Mid-Atlantic Fishery Management Council (MAFMC). The FMP currently allows an annual butterfish catch (USA and foreign combined) of up to 16,000 mt (MAFMC), 1985), which is equivalent to the Maximum Sustainable Yield (MSY) for this species. The allowable domestic harvest is less than or equal to 16,000 mt, minus the DWF bycatch Total Allowable Level of Foreign Fishery (TALFF). The TALFF equals 6% of the allocated portion of the *Loligo* TALFF and 1% of the allocated portions of the *Illex*, mackerel, silver hake and red hake TALFF's (MAFMC, 1985).

Commercial Fishery

The total international catch of butterfish declined 13% from 5,429 mt in 1985 to 4,732 mt in 1986 (Table II 1.1). The distant-water fleet (DWF) catch declined 80% to 164 mt in 1986, representing the lowest butterfish catches by DWF's on record. USA catches declined slightly from 4,626 mt in 1985 to 4,568 mt in 1986. The decline in domestic catches since 1984 is attributed to decreased availability of market size butterfish on the traditional southern New England fishing grounds.

Discard rates of small butterfish in the domestic fishery continued to be relatively high (40-70% by weight of the landed catch) for most of 1986. However, beginning in December 1986 the cull was running medium-small versus small-supersmall throughout most of 1986. Thus, discard rates in 1987 may decline from the high rates reported in recent years.

Landings per unit effort (LPUE) in 1986 increased 4% above the 1985 level during the Jan-Jun period despite a 50% reduction in both international landings (L) and effort (f) (Table II.1.2). Whereas, during the Jul-Dec period (LPUE), (L), and (f) increased 29%, 50%, and 17% above 1985 levels.

Several mesh selectivity experiments conducted in the past decade in which butterfish was a principal by-catch species were examined. These studies indicate that mesh sizes <76 mm (3.0 in) catch large numbers of small (<12 cm), thus unmarketable butterfish, and mesh sizes ≥100 mm (4.0 in) will allow some marketable fish to escape and result in a loss of yield per recruit (Meyer and Merriner 1976; Murawski and Waring 1979; Gillikin et at. 1981; and

Anderson et al. 1983). However, these nets capture 13-14 cm butterfish which may be discarded if they dominate the catch (NMFS, unpublished data).

Survey Abundance Indices

Indices of relative abundance and biomass (number and weight) from the NEFC 1986 bottom trawl survey declined 52% and 55%, respectively from 1985 values (Table II.1.3). Likewise, the recruitment index (number per tow at age 0) and the age 1+ index declined 51% and 56%, respectively. Also, the 1986 recruitment (140.2), age 1+ (44.3), and biomass (6.8 kg) indices are nearly equal to the 18-year (1968-1985) averages (144.6, 45.3, and 7.0). The decline in age 1+ abundance is largely attributed to declines in age 1 fish. Abundance estimates of ages 2 and 3 fish are comparable to the high values observed in the past 3-years (1983-1985), whereas age 4 fish abundance is the highest on record.

Total Mortality

Total instantaneous mortality (Z) rates between ages 0/1, 1/2, and 2/3 increased 98%, 5%, and 16%, respectively from 1984/85 to 1985/86 levels (Table II.1.4). However, between ages 3/4 the Z value declined 44%. The mean Z's between ages 0/1 and 1/2 in recent years 1978/86 are below the corresponding values for the previous 10-years (1968/77) (Table II.1.4), while the Z between ages 2/3 is slightly higher in the recent time period.

Summary

Although 1986 survey abundance indices are the lowest observed since 1983, they are generally above 1968-1976 levels when total butterfish catches were high (6500-19500 mt). This suggests that sufficient fish are available to support a catch up to the maximum (16,000 mt) currently allowed by the FMP. However, a limitation to achieving catch rates approaching MSY may be the spatial and seasonal nature of the USA fishery. This fishery is currently prosecuted principally in autumn in southern New England waters (Waring 1986), while the pre-1977 DWF fleets harvested butterfish throughout its range.

High discard rates that have beset the fishery over the past several years may have eased as evidenced by an increase in the cull size in late 1986. Presently, the butterfish market remains strong, which, combined with increased availability of marketable size fish, should maintain effort and landings at or above 1986 levels.

The decline in the mean Z between ages 1/2 fish since 1978 probably reflects the decline in total DWF fishing mortality. The DWF fishery on butterfish was conducted principally in winter, thus impacting on recruiting age 1 fish. The mean Z's between ages 0/1 for the two time periods are nearly identical, which implies that current domestic fishing mortality rates are equivalent to historical DWF levels, assuming that natural mortality has remained constant at 0.8 over time. The similarity in the Z's between ages 2/3 fish probably reflects a market preference, thus the directed effort on larger fish.

DISCUSSION

Problems noted in the assessment include occasional inconsistencies in survey indices between NEFC fall survey (NE) and the Massachusetts inshore survey (MA). The NE survey occasionally misses strong year classes of age 0 butterfish (e.g. 1982). Possible causes include the availability of fish to the gear, timing of cruises relative to concentrations of butterfish, etc. Total indices produced by the NE and MA surveys often are not consistent. For example, the MA survey identified a strong year class in 1982 while the NE survey did not. On the other hand, subsets of the indices (e.g. MA Region 3) do track the NE survey more closely. In the MA data the log of the pre-recruit index for the deepest strata versus temperature produced a close correlation.

Differences in the two surveys were noted. The MA survey is consistently conducted earlier (and therefore at warmer temperatures) in the year, and more inshore than the NE survey for any given area. Also, the MA survey is conducted only during daytime hours.

Problems identified in the conduct of the fishery include high discards in years in which abundant year classes recruit to the gear. The mesh required to maximize yield/recruit seems to be 3 - 3 1/2". It appears that this is the mesh that most fishermen are now using. Automatic sorters and conveyers may increase the discard problem since they allow fishermen to fish in areas in which small fish concentrate or, potentially, to use a smaller mesh than they would otherwise because the automated sorting allows them to cull the deck more quickly. The cost associated with these technological innovations is an increase in the proportion of discards relative to landed catch.

SUMMARY OF PRESENTATION

The stock is strong, there are more older (age 2+) fish available now then during the days of intensive foreign fishing, and there appears to be a higher CPUE and a lower total mortality now than during pre-FCMA days. There may be some potential for expansion of the fishery, if done in areas that are not now fished, specifically, portions of Georges Bank in autumn and offshore waters south of southern New England in winter (Waring 1986).

COMMENTS

1) A comparison should be made of CPUE from pre- and post-FCMA days.

2) Data deficiencies include the fact that the butterfish historical (pre-FCMA) catch and effort is difficult to derive because the foreign fishery reported "total pelagics" and, consequently, one must extrapolate butterfish (or other pelagic species) from the total.

3) Q: There appears to have been an increase in fishing mortality and a low 1986 survey index. How does this relate to the summary statement that things are "strong?"

A: Z is still high because the domestic fishery is still fishing heavily and discard mortality is high. Also, the survey index would be of concern except for the fact that the age-specific total mortality shows that the 2+ fish didn't decline as much as the 0 and 1+ groups so total z is probably not increasing. The conclusion is that the survey failed to represent the relative abundance of the 0's and 1+ fish in 1986, due to reasons of availability or other factors.

4) Q: Were discards as high in 1986 as in 1985?
A: They were probably the same, therefore, it would be difficult to attribute the decline in Z to a change in discard mortality on 0 and 1+ fish.

5) Q: Are survey low points associated with day versus night tows?
A: This question was addressed in the late 1970's for a number of species (including butterfish). It was not evaluated as a possible cause of the anomalous survey results (NE vs MA) in 1982. Another possible cause of the anomaly in 1982 is the inshore/offshore distribution of butterfish and the influence of water temperature on inshore catch rates. This was evaluated but the results did not indicate this to be a cause.

Table II.1.1. Nominal catch (mt) of butterfish from Northwest Atlantic Fisheries Organization (NAFO) Subareas 5 and 6.

YEAR	US	FOREIGN	NOMINAL CATCH	ADJUSTED NOMINAL CATCH[1]
1983	4,905	630	5,535	6,816
1984	11,972	429	12,401	16,854
1985	4,626	803	5,429	7,912
1986[2]	4,568	164	4,732	6,368

[1] Adjusted to account for non-reported discards of countries not reporting butterfish from directed *Loligo* fishing operations (Murawski and Waring, 1979). The 1976-1986 adjusted catch incorporate estimated discards in US fishery.

[2] Provisional

Table II.1.2. International landings (C), USA (LPUE, landings per unit effort, mt/day), and international effort (f) expressed as equivalent USA days fished.

	Jan-Jun			Jul-Dec		
Year	C	LPUE	f	C	LPUE	f
1976	10164.7	2.20	4620.3	1716.3	3.69	465.1
1977	3182.4	7.66	415.5	1470.6	5.05	291.2
1978	1549.5	8.83	175.5	3452.5	8.64	399.6
1979	1562.4	7.64	204.5	2108.6	6.12	344.5
1980	1491.4	6.79	219.6	4743.6	13.05	363.5
1981	2090.2	14.16	147.6	3700.8	11.85	321.3
1982	2199.9	13.12	167.7	7490.8	22.59	331.6
1983	1467.6	12.79	115.5	4067.7	13.39	303.7
1984	6763.6	40.33	167.7	5637.4	20.91	269.6
1985	3451.0	16.77	205.8	1977.1	12.02	164.5
1986[1]	1740.4	17.40	100.0	2991.9	15.52	192.8

1 Provisional.

Table II.1.3. Indices of Relative Abundance (stratified mean catch per tow) for butterfish by Age Group Derived from NEFC autumn bottom trawl survey data.

YEAR	AGE 0	AGE 1+	TOTAL	WEIGHT (kg)
1983	358.8	92.5	451.3	12.8
1984	268.6	93.4	362.0	11.4
1985	286.3	100.4	386.7	15.2
1986	140.2	44.3	184.4	6.8

* Strata 1-12, 61-76, 13, 14, 16, 19, 20, 23, 25 (offshore); 1-46 (inshore).

Table II.1.4. Total mortality rates (Z) for butterfish derived from NEFC autumn abundance indices from NEFC trawl survey data.

Year	AGE 0/1	1/2	2/3	3/4
1968/69	.78	3.17	2.33	---
1969/70	1.26	3.09	3.05	---
1970/71	1.10	2.78	1.28	---
1971/72	3.22	3.34	2.64	---
1972/73	.97	1.72	1.49	---
1973/74	2.01	2.77	1.40	---
1974/75	1.54	2.23	2.45	---
1975/76	.01	2.11	1.65	---
1976/77	1.22	1.45	2.18	---
1977/78	1.79	1.17	1.78	---
1978/79	.61	.50	4.03	---
1979/80	1.06	1.36	1.88	1.50
1980/81	1.60	1.83	4.17	4.29
1981/82	2.20	2.30	4.52	.73
1982/83	.02	.89	.38	.69
1983/84	1.51	1.96	1.34	---
1984/85	1.14	1.86	1.58	3.43
1985/86	2.26	1.95	1.84	1.93
68/77 MEAN	1.39	2.38	2.03	---
78/86 MEAN	1.30	1.58	2.47	---

2. MACKEREL

Source Document: Overholtz, W., and B.L. Parry. 1986. Update of the Status of the Northwest Atlantic Mackerel Stock for 1986. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 86-13, 15 p.

The current status of mackerel is described in the source document. The population has been increasing steadily and several strong year classes have recruited in recent years. Present catches are small compared to those occurring from 1969-1976, and fishing mortality estimated from VPA is low. Updated data are presented in Tables II.2.1 through II.2.3. Input parameters for catch projections are given in Table II.2.4. Catch and stock size projections for 1987-88 are given in Table 11.2.5. At an estimated 1986 catch of 65,000 MT, F for age 3^+ mackerel in 1986 would be 0.07. Assuming moderate sized 1984 and 1985 year classes, catch at $F_{0.1}$ (0.29) in 1987 will be 325,000 MT. This catch level is likely to be excessive considering the fact that several years of catches at the 250-400,000 MT level resulted in rapid stock decline during the early 1970's.

Table II.2.1. Mackerel catch (mt) from NAFO SA 2-6 during 1960-1987.

Year	US Commercial	US Recreational	Canada	Other Countries[1]	Commercial Total	Grand Total
1960	1,396	2,478	5,957	--	7,353	9,831
1961	1,361	3,022	5,459	11	6,831	9,853
1962	938	3,565	680	175	7,914	11,479
1963	1,320	3,981	6,363	1,299	8,982	12,963
1964	1,644	4,343	10,786	801	13,231	17,574
1965	1,998	4,292	11,185	2,945	16,128	20,420
1966	2,724	4,535	11,577	7,951	22,252	26,787
1967	3,891	4,498	11,181	19,047	34,119	38,617
1968	3,929	7,781	11,134	65,747	80,810	88,591
1969	4,364	13,050	13,257	114,189	131,810	144,860
1970	4,049	16,039	15,710	210,864	230,623	246,662
1971	2,406	16,426	14,942	355,892	373,240	389,666
1972	2,006	15,588	16,254	391,464	409,724	425,312
1973	1,336	10,723	21,619	396,759	419,714	430,437
1974	1,042	7,640	16,701	321,837	339,580	347,220
1975	1,974	5,190	13,544	271,719	287,237	292,427
1976	2,712	4,202	15,746	223,275	241,733	245,935
1977	1,377	522	20,362	56,067	77,806	78,328
1978	1,605	6,571	25,429	841	27,875	34,446
1979	1,990	3,723	30,244	440	32,674	36,397
1980	2,683	2,381	22,136	566	25,385	27,766
1981	2,941	5,052	19,294	5,361	27,596	32,648
1982	3,330	1,131	16,379	6,647	26,356	27,487
1983	3,805	3,000	19,785	5,955	29,545	32,545
1984	5,954	2,583	16,995	15,045	37,994	40,577
1985	6,632	3,813	27,948	32,409	67,840	70,802
1986	9,637	4,000	23,700	25,355	58,692	62,692
1987[2]	10,217	4,000	25,000	33,949	69,166	73,166

[1] Includes catch taken by Poland in a research fishery from 1982-1987.

2 Estimated

Table II.2.2. Age composition (thousands of fish) of the 1986 mackerel catch from NAFO SA 2-6.

		SA 5-6				
Age	SA 2-4 Total	U.S. Commercial	U.S. Recreational	Other Countries	Total	Total
1	174	395	362	523	1,280	1,454
2	1,967	3,733	2,254	4,349	10,336	12,303
3	3,051	926	404	2,317	3,647	6,698
4	31,643	13,565	5,491	43,157	62,213	93,856
5	8,228	3,614	1,869	9,404	14,887	23,115
6	529	412	251	697	1,360	1,889
7	289	76	47	113	236	525
8	551	693	467	1,782	2,942	3,493
9	102	16	7	81	104	206
10	261	93	47	317	457	718
11	545	193	91	669	953	1,498
12	418	500	278	1,201	1,979	2,397
13	203	118	58	324	500	703
14+	0	241	191	271	703	703
Total	47,961	24,575	11,817	65,205	101,597	149,558
Weight (mt)	23,700	9,637	4,000	25,355	38,992	62,692

Table II.2.3. Mackerel commercial and recreational catch at age (millions of fish) from NAFO SA 2-6 during 1962-86.

Year	Age 0	1	2	3	4	5	6	7	8	9	10	11	12	13	14+	Total	Weight[1]	Mean age
1962	-	16.1	2.8	15.2	3.8	1.2	1.6	1.4	0.8	0.4	0.1	0.3	-	-	-	43.7	11.5	2.8
1963	-	1.1	4.2	1.3	26.3	6.0	0.3	0.2	0.2	0.2	0.1	0.1	-	-	-	40.0	13.0	4.1
1964	-	12.9	7.0	4.1	4.0	19.4	4.1	3.9	0.7	0.8	0.2	-	-	-	-	57.1	17.6	3.8
1965	-	9.0	3.6	2.9	4.0	5.2	19.5	4.2	4.0	0.7	-	-	-	-	-	53.1	20.4	4.7
1966	-	24.0	11.5	5.3	2.6	4.7	7.9	21.8	0.5	0.2	-	-	-	-	-	78.5	26.8	3.9
1967	1.8	0.8	26.7	19.8	3.5	3.3	5.1	6.1	32.3	0.3	-	-	-	-	-	99.7	38.6	4.8
1968	1.1	141.4	61.5	59.3	38.1	14.3	6.6	0.7	1.0	6.1	0.1	-	-	-	-	330.2	88.6	2.3
1969	4.0	7.1	262.1	160.7	65.8	5.7	3.0	2.0	3.1	2.2	8.3	-	-	-	-	524.0	144.9	2.8
1970	4.8	193.5	54.5	522.1	162.9	27.6	7.0	5.3	9.9	10.0	3.8	2.8	-	-	-	1,004.2	246.7	3.0
1971	2.4	74.6	294.2	127.4	558.9	203.5	34.6	8.9	3.6	4.3	8.1	7.2	-	-	-	1,327.7	389.7	3.6
1972	3.6	22.1	85.7	256.2	182.6	390.4	87.3	24.0	4.2	8.2	3.8	5.6	-	-	-	1,073.7	425.3	4.2
1973	4.0	161.8	283.2	285.1	233.6	192.4	197.2	31.2	11.0	4.1	3.8	1.6	-	-	-	1,409.0	430.4	3.6
1974	2.0	95.9	242.2	264.4	101.5	114.3	111.8	108.3	25.7	6.4	2.5	0.8	-	-	-	1,075.8	347.2	3.8
1975	3.7	373.7	431.4	113.7	100.8	58.6	67.8	51.9	50.5	12.5	2.3	1.0	-	-	-	1,267.9	292.4	2.8
1976	-	12.5	353.5	272.5	85.7	52.4	27.3	40.5	34.6	22.6	13.4	1.4	-	-	-	916.4	245.9	3.5
1977	-	2.0	27.0	101.0	54.0	12.0	9.9	5.6	6.3	3.8	3.6	0.3	0.3	-	-	225.8	78.3	3.8
1978	-	0.1	0.2	4.7	17.4	13.3	8.4	4.7	2.2	4.5	1.5	4.6	0.6	0.6	-	62.8	34.4	5.9
1979	-	0.4	0.6	1.3	7.1	18.6	13.1	6.2	2.6	2.2	2.3	0.7	1.9	0.6	1.0	58.6	36.4	6.2
1980	-	1.2	10.9	1.0	1.0	6.9	13.8	4.7	2.0	1.0	1.0	1.6	0.5	1.3	0.8	47.7	27.8	5.6
1981	+	10.4	4.8	8.7	2.0	2.8	7.9	13.1	5.6	2.7	0.9	0.4	0.4	0.7	0.8	61.2	32.6	5.1
1982	+	3.6	9.9	2.7	8.4	1.2	2.7	4.4	8.1	2.6	1.3	0.6	0.3	0.7	1.3	47.8	27.5	5.4
1983	-	2.2	14.2	4.5	1.4	6.8	0.7	1.3	4.8	11.8	5.3	1.2	0.7	0.4	0.8	56.0	32.5	5.9
1984	-	0.5	44.0	29.7	3.4	1.2	4.7	0.6	0.6	3.4	7.8	2.9	0.9	0.6	1.6	102.0	40.6	4.1
1985	-	3.4	1.9	140.9	33.7	2.7	0.8	3.2	0.2	0.5	2.4	4.5	2.4	0.6	1.2	198.6	70.8	3.7
1986	-	1.5	12.3	6.7	93.9	23.1	1.9	0.5	3.5	0.2	0.7	1.5	2.4	0.7	0.7	149.6	62.7	4.4

[1] Thousands of mt.

Table-II.2.4. Input data for forecasts of catch in 1987-88 and stock in 1988-89 of mackerel in NAFO SA 2-6.

Age	Stock Size in 1986 (millions)	Exploitation pattern	Mean weight of the catch (kg)	Mean wt of stock on Jan. 1 (kg)	Maturity ogive
1	750.0	0.04	.079	.071	0.00
2	612.2	0.28	.234	.211	0.50
3	787.9	1.00	.349	.314	1.00
4	117.9	1.00	.366	.329	1.00
5	1,653.0	1.00	.452	.407	1.00
6	406.7	1.00	.581	.552	1.00
7	33.4	1.00	.640	.608	1.00
8	8.8	1.00	.729	.608	1.00
9	61.6	1.00	.777	.693	1.00
10	3.5	1.00	.750	.713	1.00
11	12.3	1.00	.738	.701	1.00
12	26.4	1.00	.717	.601	1.00
13	42.2	1.00	.776	.737	1.00
14+	24.6	1.00	.781	.742	1.00

Table II:2.5. Projected catch of mackerel in 1988 in NAFO SA 2-6 and accompanying fishing mortality (F 3+) with spawning stock biomass (SSB) in 1989 along with percent change from 1988 SSB. These forecasts assume a 1987 catch of 73,000 mt and recruitment of 750 million fish for the 1987 and 1988 year classes at age 1 respectively.

F88	CATCH 88 (000's mt)	SSB 89 (000's mt)	% change in SSB from 1988 (1,461,000 mt)
0.05	68	1,420	-2.8
0.10	133	1,359	-7.0
0.15	195	1,301	11.0
0.20	254	1,246	14.7
0.25	310	1,193	-18.3
0.29*	353	1,153	-21.1
0.35	415	1,095	-25.1

$F_{0.1}$

3. LONG-FINNED SQUID

Source Document: Lange, A.M.T. 1984. An Assessment of the Long-Finned Squid Resource off the Northeastern United States-Autumn 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-37, 24pp.

The Fishery

The USA *Loligo* fishery reported about 67% (7,531 mt) of the 1986 directed US catch from Subarea 5 (primarily south of Cape Cod), with 3,801 mt (approximately 32%) taken in Subarea 6 (the mid-Atlantic area). Joint venture (JV) catches accounted for an additional 1,947 mt of USA catch. The total domestic harvest of 13,292 mt represented a 31% increase from 1985 landings (Table II.3.1). Domestic landings were distributed throughout the year with peaks during May through August (Table II.3.2). The fishery continued to be dominated by 50-150 GRT vessels, as has been the case since 1978. Most of the directed catch (defined as catch from those trips for which squid accounted for over 75% of the total) prior to 1984 was attributed to the inshore fishery in Vineyard and Nantucket Sounds (Statistical Area (SA) 538). In 1984, the directed catch in SA 537 (offshore, Southern New England) increased to account for 28% of the directed total, compared to less than 5% in previous years. This area accounted for 66% and 46% of the total directed catch during 1985 and 1986. Catches in Subdivision 6A (off New York and New Jersey), which had generally accounted for less than 20% of the directed catch, accounted for 34% of the directed catch during 1986, an increase in the importance of that area to the fishery.

The distant-water-fleet (DWF) catch during 1986 was 4,598 mt (Table II.3.1), a 30% decline from 1985. Total catch (USA and DWF) during 1986 was about 14% above that taken in 1985, but about 25% below the average seen since the foreign directed fishery began (1970-84).

Commercial Length Frequencies

Length frequency data from the 1986 USA fishery in SA 537-539 indicate the presence of several age classes throughout most of the year. Significant numbers of large individuals ($\geq$ 25 cm, probably about 20-24 months) were present in May, and again in July through September. One size class, first seen in June at about 12 cm, dominated the catch through September (about 18 cm). Another size class entered the fishery in October (9 cm) and was probably spawned during the spring. Similar size distributions were evident in the samples taken in SA 611-636 (Mid-Atlantic) fishery. One major difference was the high proportion of small ($\leq$ 9 cm) squid, probably spawned during late summer-autumn 1986, which were taken in December.

DWF catches in SA 611-636 during January-March were primarily of one size class, ranging from 8 to 14 cm. Catches during October through December consisted of two size classes, one increasing from about 8 to 10 cm, and the other from about 13 to 18 cm.

Commercial Catch-per effort

Catch-per-unit-effort (CPUE, metric tons per days fished) indices from the USA directed fishery (as defined above) are given in Figure II.3.1 for 1976-86. This index is based on all directed otter trawl trips in Subareas 5 and 6, and reflects the relative availability of *Loligo* to the directed fishery. The 1986 index reflects a 5.5% increase in CPUE over the 1985 index, and is 34% greater than the 1976-85 mean.

Research Vessel Surveys

Minimum biomass and abundance estimates based on areal expansion of stratified mean weights and numbers per tow are provided in Table II.3.3. These estimates assume 100% catchability of *Loligo* during daytime, while nighttime tows are adjusted upward to account for off-bottom movements during that time. The 1986 estimates were substantially below those seen since 1983. However, the biomass estimate was 49% above the 1968-82 mean. Most of the decrease from the 1985 estimate seems to be attributable to lower nighttime catches in the Georges Bank area.

The 1986 NEFC autumn bottom trawl survey abundance index (stratified mean number per tow) for the Mid-Atlantic through Georges Bank strata was the second highest of the series (1967-85), 58% above the 1968-85 mean (Table II.3.4, Figure II.3.1). The pre-recruit (<8 cm dorsal mantle length individuals) index was also the second highest since 1967, 50% above the 1968-85 mean.

The commercial CPUE index during 1976-86 generally followed the same trend as the research survey indices for the same year (Figure II.3.1). During 1986 both indices increased from their 1985 levels. For *Loligo*, USA CPUE is primarily a measure of the spawning portion of the stock during the spring and summer, while the survey index is comprised predominantly of pre-recruits, progeny of those spawners. The consistency of these two measures suggests a relationship between spawners and recruits.

Prospects for 1987

Total abundance during the autumn 1986 survey, based on daytime tows, was 3.2 billion. Pre-recruits accounted for 79.6% of the total (2.5 billion). If 55% of the pre-recruits are from the spring cohort, and catchability is 45% (Lange, 1984), 3.1 billion [2.5·(0.55/0.45)] recruits are estimated from that cohort. The autumn cohort is assumed to contribute additional recruits equivalent to about 18% (on average) of those from the spring cohort (0.56 billion). Total recruitment from the 1986 year class is therefore estimated to be 3.6 billion.

Table II.3.5 contains estimates of potential yield of *Loligo* from the 1986 year class, assuming 3.6 billion recruits, for an offshore/inshore and an inshore fishery and a range of fishing mortality rates. The nature of the current fishery probably falls somewhere between these two models. Lange et al. (1984), assuming a moderate stock-recruitment relationship, found the highest equilibrium yield associated with an F of 0.70. Yield from the 1986

year class at an F level of 0.70 would be expected to range between 51,000 and 60,000 mt. The average F during 1978-81 was estimated as 0.41. Yield from the 1986 year class at an F level of 0.41 would be expected to range between 42,000 and 48,000 mt. However, the current F level is probably significantly lower than that seen during 1978-81 and yield from the 1986 year class is expected to be lower as well.

Conclusions

Above average apparent abundance of both adults and pre-recruits during the autumn 1986 NEFC research vessel survey suggest that current abundance of Loligo is more than adequate to provide catches, during 1987, at the initial optimum yield level established in the 1987 Annual specifications for the Fishery Management Plan (23,629 mt).

The recent development of the USA Loligo fishery and subsequent reductions in the offshore foreign fishery have significantly changed the seasonal pattern of the Loligo fishery. When the DWF dominated the fishery, the bulk of foreign catch was taken during November-March and the autumn NEFC pre-recruit index was an appropriate measure of abundance and availability to the major portion of the fishery. The USA fishery takes most of its Loligo catch during May-August. Factors effecting recruitment to this spring-summer fishery, should be investigated to provide additional information relative to predictions of inshore availability.

Discussion

Concerns were raised relative to the continued use of an assessment model developed during the period dominated by the offshore DWF fishery, while in recent years the domestic inshore fishery has produced the majority of the catch. It was pointed out, however, that the current model is used to provide a range of potential yield estimates assuming both an inshore and a traditional offshore/inshore fishery, taking into account differences in the two fisheries including size composition of the catch. The assessment incorporates yield-per-recruit and spawning-stock biomass-per-recruit analyses, and is updated annually based on autumn survey results.

A primary concern of the managers of the industry is how the autumn survey indices used to generate potential yield estimates relate to subsequent availability of squid to the fishery. The survey abundance estimates do take the clustered distribution of squid into account because mean numbers per tow are weighted by the size of the strata prior to summing to represent the entire area. However, Loligo availability to the inshore fishery in the following spring cannot be predicted from autumn surveys. Further information on the relationship between concentrations seen in the NEFC autumn survey and subsequent availability to the spring/summer inshore fishery were referred to Working Group II. Three questions were raised by workshop participants:

Q: Is quota management for a short-lived species such as squid reasonable?

A: The workshop participants felt this should be addressed by managers.

Q: Where is the detailed information on how the assessment is done and what biological information is incorporated in it?
A: The source document and cited literature contain these details.

Q: How accurate is the MSY estimate given that the DWF quotas have never been reached?
A: It was pointed out that restrictions in when and where the DWF could fish and low initial allocations each year may have contributed to their inability to reach their quotas.

Q: The use of survey data to estimate absolute population size was questioned.
A: Expanded survey estimates of population size are widely used in stock assessments, and could, in fact, be used for other species based on NEFC surveys to provide total population estimates. The short lifespan (and lack of age data) of Loligo and continued changes in the nature of the fishery were identified as factors which preclude use of fishery data to estimate squid population size. The autumn survey has been shown to closely track offshore catches which are taken in the winter when the population has moved offshore, indicating that the approach may be reasonable.

On review of the rapporteur's report, the workshop participants noted that this technique is used widely to estimate stock size of fishery resources throughout the world.

An interesting observation presented by one observer relative to changes in the timing of inshore migrations of Loligo was that, for the trap fishery in Nantucket Sound, the first catches have occurred on approximately the same date, each year, for many years.

Table II.3.1. Annual long-finned squid catches (in metric tons) from the Northwest Atlantic (Cape Hatteras to Gulf of Maine) by the USA[1] and the distant-water-fleet (DWF), 1963-86.

Year	USA	DWF	Total
1983	15,943	11,720	27,663
1984	11,592	11,031	22,623
1985	10,155	6,549	16,704
1986	13,292	4,598	17,890

1. Includes joint venture catches made by USA catcher vessels.

Table II.3.2. Landings of *Illex* squid from the 1986 USA fishery by month and Statistical Area.

Area	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
512	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1
513	0	0	0	0	0	0.2	0	0.1	0	0.5	1.2	0.2	2.2
514	0	0	0	0.1	0	0.8	0	0	0.4	0.2	0.2	0.7	2.4
515	0	0	0	0	0	0	0	0	0	0	0.1	0	0.1
521	0	0	0	0	0	0	0	0	0.6	0	0	0	0.6
523	0	0	0	0	0	0.4	0	0	0	0	0	0	0.4
537	0	0	0	0	0	0	2.2	0	0	0	0	0	2.2
616	0	0	0	0	0	0	0	0	0	0	0	1.8	1.8
622	0	0	0	0	27.2	21.6	480.6	1108.4	1177.1	0	0	0	2814.9
626	0	0	0	0	0	36.2	40.6	0	0	0	0	0	76.7
632	0.1	0	0	1.3	8.4	2	91	62.2	64.8	6	0.2	1.2	237.1
636	0	0	0	0	0	3	0	0	56.4	0	0	0	59.4
Total	0.1	0	0	1.4	35.6	64.2	614.4	1170.7	1299.3	6.7	1.8	3.9	3197.9

Table II.3.3. *Loligo pealei* minimum biomass (metric tons) and abundance (in millions) estimates[1] for the Mid-Atlantic to Gulf of Maine, 1968-86.

Year	Biomass	Abundance
1983	62,363	4,460
1984	66,122	4,670
1985	55,612	4,865
1986	47,029	3,139
1968-82 mean	31,558	3,317

1) From areal expansion of stratified mean weights (kg) and numbers per tow assuming 100% catchability during daytime. Nighttime catch data were expanded to account for diel differences in catch (Sissenwine and Bowman 1978).

Table II.3.4. Total and pre-recruit (<8 cm) stratified mean numbers per tow[1] of *Loligo pealei* from the NEFC autumn bottom trawl surveys (Mid-Atlantic to Georges Bank), 1967-86.

Year	All sizes	Pre-recruits
1983	373.4	251.1
1984	299.8	152.2
1985	442.2	310.8
1986	453.0	360.4
1968-85 mean	295.9	240.0

1) Stratified mean number per tow of all sizes and of individuals ≤ 8 cm mantle length.

Table II.3.5. Estimated yield (in metric tons) of long-finned squid associated with various levels of fishing mortality and the 1986 recruitment level of 3.6 billion individuals for the offshore/inshore and inshore fisheries (assuming a moderate stock-recruitment relationship).

F	Offshore/Inshore	Inshore
.27	32,300	35,898
.41	42,362	47,941
.55	48,618	55,420
.70	50,700	59,850
.93	46,926	59,082

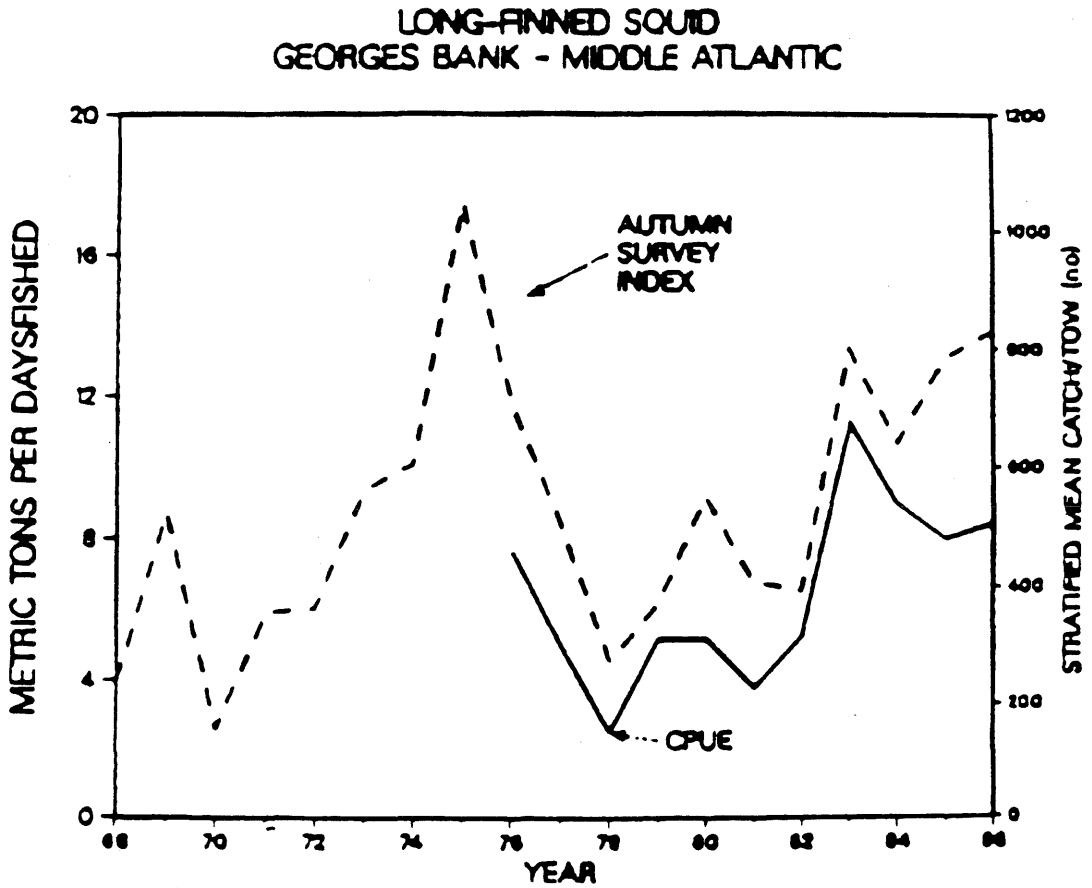


Figure II.3.1. Stratified mean number per tow of long-finned squid from the NEFC autumn bottom trawl survey, and commercial CPUE in the directed squid fishery (otter trawl trips in all areas, where squid made up over 75% of the trip catch).

4. SHORT-FINNED SQUID

Source Document: Lange, A.M.T. 1984. Status of the Short-Finned Squid (Illex illecebrosus) off the Northeastern USA, November 1984. NMFS, NEFC, Woods Hole Lab. Ref. Doc. No. 84-38, 20 pp.

The Fishery

The USA Illex fishery was conducted entirely in Subarea 6 (Mid-Atlantic area), during 1986, with only about 8 mt reported from Subarea 5 (New England). This reflects the recent increased relative importance of the directed fishery in the Mid-Atlantic area. The total domestic harvest was 5,176 mt during 1986, up 4% from the 1985 landings, and over five times the 1968-82 average (Table II.4.1). Joint ventures with Spain and Italy, accounted for about 38% of the domestic catch compared with about half the 1985 catch. About 96% of the domestic landings were made during July-September and from the area south of Delaware Bay (SA 622-636, Table II.4.2). The fishery was dominated by ton class 3 and 4 otter trawl vessels (51-150 GRT and 151-500 GRT) as it had been since the directed fishery began, around 1982. Large, ton class 6 (>900 GRT) vessels which had accounted for about half of the domestic Illex catch during 1985, did not participate in this fishery in 1986.

The distant-water-fleet (DWF) catch, during 1986 was 248 mt (Table II.4.1), 76% below the 1985 DWF catch, and the lowest since that fishery began in the early 1970's. Total catch (USA and DWF) during 1986 (5,422 mt) was about 10% less than that taken in 1985 and the lowest since 1972. The recent low DWF catches are due to limited allocations to those countries.

Length frequency data from the 1986 USA fishery in Subarea 6 indicate presence of a single age class, taken at an average of 13 cm during May and increasing in average size to about 18 cm by September. Additional modes at about 10 and 25 cm were also seen in the September joint venture catches. Average size of individuals taken by the DWF in the Loligo fishery was about 15 cm during January-February. October catches were dominated by 20 cm individuals, while two modes, one at 11 and another at 16 cm, were seen in November DWF catches.

Catch (metric tons) per unit effort (days fished) indices from the USA directed fishery, defined as those trips where over 50% of the catch was Illex, are given in Figure II.4.1, for 1982-86. This index is based on all otter trawl trips in areas 622-636 (which accounted for 99.6% of the 1986 catch), and reflects the relative availability of Illex to the directed fishery which began in 1982. CPUE in 1986 was about 17% above the 1982-85 mean, and 27% above the 1985 level.

Research Vessel Surveys

The 1986 NEFC autumn bottom trawl survey abundance index (stratified mean number per tow) for Mid-Atlantic through Georges Bank strata was about 60% greater than that for 1985 but 18% below the average during the recent period of low abundance (1982-85) and 74% below the 1968-85 mean (Table II.4.3,

Figure II.4.2). The pre-recruit (≤10 cm dorsal mantle length individuals) index was 67% greater than the 1985 level and comparable to the recent (1982-85) mean, but it was only about one-third of the 1968-85 mean. Catches of this size class are generally low and provide little information regarding subsequent availability.

Catch-per-tow index trends from each of the three major strata sets (Southern New England and Mid-Atlantic, Georges Bank, and the Gulf of Maine) reflect similar patterns in apparent abundance (Figure II.4.3). The 1986 index for the Gulf of Maine was about one third the 1985 level while the indices for the other areas were slightly higher than in 1985.

Conclusion

Continued low apparent abundance of both adults and pre-recruits during the autumn 1986 NEFC research vessel survey suggest that current abundance of *Illex* may not be adequate to provide catches during 1987 at the optimum yield level established in the Annual Specifications of the *Illex* Fishery Management Plan (15,038 mt). However, the survey only covers a portion of this stock's range and depends on availability of the stock within the survey area and therefore may underestimate total abundance. Also, harvest of *Illex* is dependent upon availability in the areas of the fishery, and since the fishery also occurs in only a portion of the species' range, it is not likely that catch levels as seen in recent years will adversely affect the stock.

DISCUSSION

Several issues were discussed relative to the update of the *Illex* squid assessment. These included the following:

Concerns were raised about the use of survey indices as estimates of relative *Illex* abundance. The stratified random design of the survey does account for the spatial aggregations of this species, however, the use of geometric versus arithmetic mean catches per tow may be argued. In the past the arithmetic mean has been used but the geometric mean may better account for the high variability in catches per tow within each strata. If *Illex* were homogeneously distributed within a strata there should be no differences between these two mean estimates.

Preliminary analyses of catch and temperature data from the spring and autumn surveys and the domestic and DWF catches indicate that about 49% of the variability in domestic catch may be accounted for by the mean temperature seen in the autumn survey. Using data prior to 1983, about 72% of the variability in the DWF catch could be accounted for by a model incorporating the mean temperature in the autumn survey and the stratified mean number per tow in the Gulf of Maine during autumn.

The usefulness of commercial CPUE as an index of availability for *Illex*, which form highly concentrated aggregations, was also discussed. It was suggested that analyses which looked at catch rates for individual trips may better account for the variability in availability than does the current index

which consists of catch and effort data pooled over the entire year and all ton classes in the area south of Delaware Bay.

Industry observers expressed concern that this is a species which may undergo dramatic fluctuations in abundance and availability, and such changes may be difficult to assess on a timely basis. All indications at present, however, are that availability is continuing to decline. Much research has been done relative to the life history and distribution of this species in cooperation with NAFO, Canada, Japan, and the USSR. This research has included analyses of oceanographic features relative to catches of larval and juvenile Illex. This species appears to spawn in very deep water below the Gulf Stream, south of Cape Hatteras. There also appears to be a single population which ranges from the area of spawning, north to Newfoundland. Recent drastic declines in availability began in the north and have progressed southward. We therefore assume that increased availability may be seen first in the more southern areas.

Table II.4.1. Annual short-finned squid landings (in metric tons) from the Northwest Atlantic (Cape Hatteras to Gulf of Maine) by the USA and the distant-water-fleet (DWF), 1963-85.

Year	USA	DWF	Total
1983	9,944	1,776	11,720
1984	9,547	676	10,223
1985	4,997	1,053	6,050
1986	5,176	250	5,422
1968-82 average	911	13,758	14,669

Table II.4.2. Loligo squid landings from the 1986 USA fishery, by market category, month and Statistical Area (excluding joint ventures).

Market category	Area (1)	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Mixed	514	0	0	0	0	0.4	2.9	0	0	0	0.3	4.2	0.9	8.8
	521	0	0	0	0	0.1	0.5	0	3.8	0	0	0.1	0	4.5
	522	0	0	0	0.1	0.1	0	0.6	12.6	0	0.2	0.1	0	13.5
	523	0	0	0	0	0.1	0	0.6	0	0	0	0	0	0.7
	524	0	0	0	0	0.1	0	0	0.1	0	0	0	0	0.2
	525	0.5	10.4	1.9	6.3	0.1	0	0	0	0	0	0	0.1	19.4
	526	11.7	21.5	49	47.4	2.4	3.9	14.3	1.9	3	8.9	2.3	20.5	186.8
	537	185.7	180.3	192.7	374.7	292.3	226.9	1851.3	693.1	259.6	171.1	334.6	296.3	5058.4
	538	0	0	0	70.7	1497.3	242.9	14	2.2	3.4	6.1	6.2	0	1842.8
	539	12.6	1.9	0.4	3.1	84.8	64	54	10.3	10.7	27.8	37.9	22.3	329.8
	611	0	0	0	1.5	86.5	295.5	145.1	7.4	15.5	7.4	12.5	11.8	583.3
	612	18.7	0.1	39.5	1.8	19.5	25.6	7.9	30.3	0.5	25.7	15.2	28.5	213.3
	613	24.2	3.7	2.6	77.5	130.1	252.4	278.1	246.3	36.8	344.3	289	195.5	1880.5
	614	0	0	0	0.2	0.1	0	0	1.3	0	0	0	0	1.5
	615	5.2	0.3	0.8	0.5	9.6	15	0.1	0	0	0	0.2	0	31.7
	616	47.3	36.9	160	156.6	6.2	0.2	0	0	0	2.1	34.5	137.3	581
	621	0.1	0	5.7	0.6	2.4	0.3	1.4	0.2	0.4	2.5	3.3	0.1	17
	622	51.2	63.7	47.8	138	13.1	0	0	0	3.3	0	0	9.2	326.3
	625	0.2	0	0	0.4	0.1	0	0	0	0	0	0	0	0.7
	626	3.3	20.2	37.7	7.7	0	0	0	0	0	0	0	0.1	69
	631	2.3	0.3	0.1	0	0	0	0	0	0	0.1	0.1	1.2	4.1
	632	7.9	1.4	4.5	0.8	0.7	0.1	0.1	0	6.8	1.4	0	0	23.8
	635	0.5	0	0	0	0	0	0	0	0	0	0	0	0.5
	Total	371.4	340.7	542.7	887.9	2146	1130.2	2367.5	1009.5	340	597.9	740.2	723.8	11197.6
Large	526	0	0	0	0	0	0	0	0	0	0.4	0	0.8	1.3
	537	0	0.5	0	0	0	0	0	0	0	2	21.5	29.6	53.6
	539	0	0	0	0	0	0	0	0	0	0	1	5.1	6.1
	611	0	0	0	0	0	0	0	0	0	0	0	1.1	1.1
	613	0	0	0	0	0	0	0	0	0	0.2	0	0.1	0.3
	616	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5
	626	0	0	0	0	0	0.2	0	0	0	0	0	0	0.2
	632	0	0.1	0	0	0.7	0	0	0	0.1	3.9	16.6	35.2	56.5
	636	0	0	0	0	0	0.1	0	0	0	0	0	0	0.1
	Total	0	0.6	0	0	0.7	0.3	0	0	0.1	6.5	39.1	72.4	119.7
Small	526	0	0.5	0	0	0	0	0	0	0	0	0	0	0.5
	537	0	0.5	0	0	0	0	0	0	0	0	3.3	0.5	4.4
	626	0	0	0	0	0	0.3	0	0	0	0	0	0	0.3
	632	0	0.6	0	0	0	0	0	0	0	1.7	1.1	4.9	8.3
	636	0	0	0	0	0	1.3	0	0	0	0	0	0	1.3
	Total	0	1.6	0	0	0	1.6	0	0	0	1.7	4.4	5.4	14.8
Total		371.4	342.9	542.7	887.9	2146.7	1132.1	2367.5	1009.5	340.1	606.1	783.7	801.6	11332.1

1 . NEFC Statistical reporting areas (Figure 1).

Table II.4.3. Short-finned squid abundance and pre-recruit indices from NEFC autumn surveys, 1968-86.

Year	Mean Number per tow[1] Total	Pre-recruit	Pre-recruit[2] ratio
1983	2.8	0.2	0.07
1984	6.4	0.4	0.06
1985	2.0	0.3	0.15
1986	3.2	0.5	0.16
1968-85 average	12.3	1.6	0.13

1. Stratified mean number per tow of all size individuals (total) and of pre-recruits ($\leq$10 cm), Mid-Atlantic to Georges Bank.

2. Ratio of pre-recruit to total mean numbers per tow.

Figure II.4.1. Catch (metric tons) per unit effort (days fished) of short-finned squid in the USA directed fishery (trips in SA 622-636 where squid accounted for over 50% of the total catch), 1982-86.

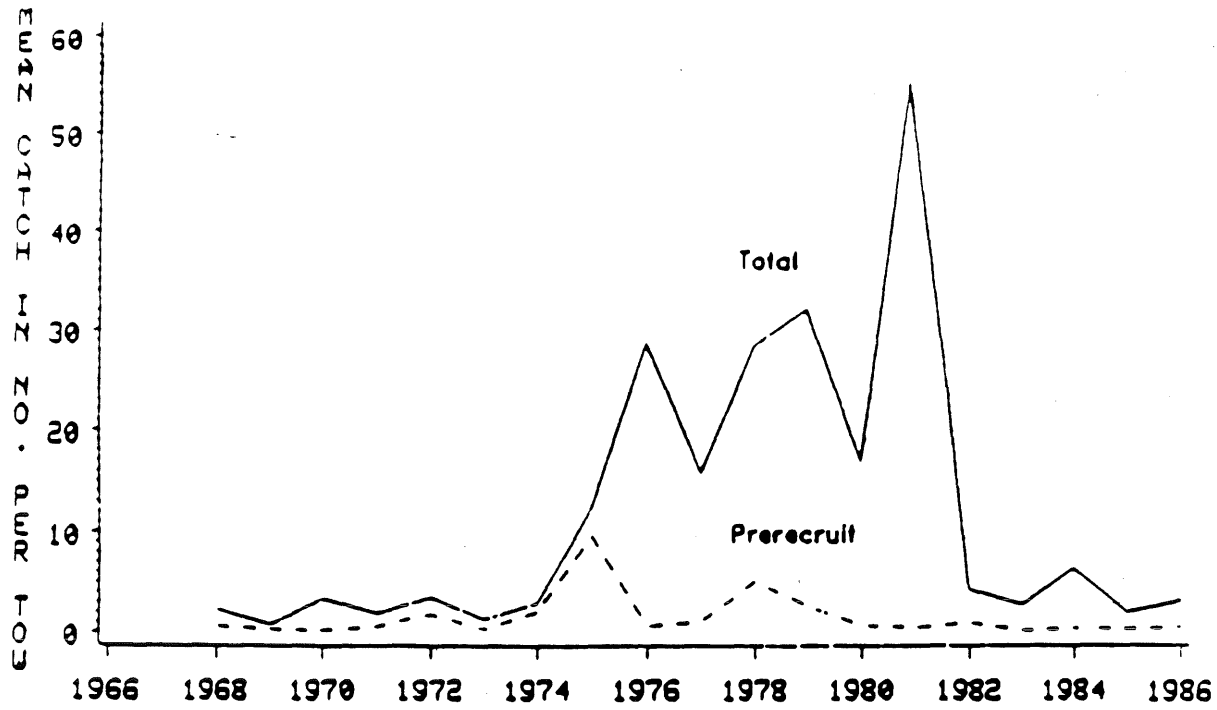


Figure II.4.2. Stratified mean number per tow of short-finned squid from the NEFC autumn bottom trawl survey, including total and pre-recruit (≤ 10 cm) indices, 1968-86.

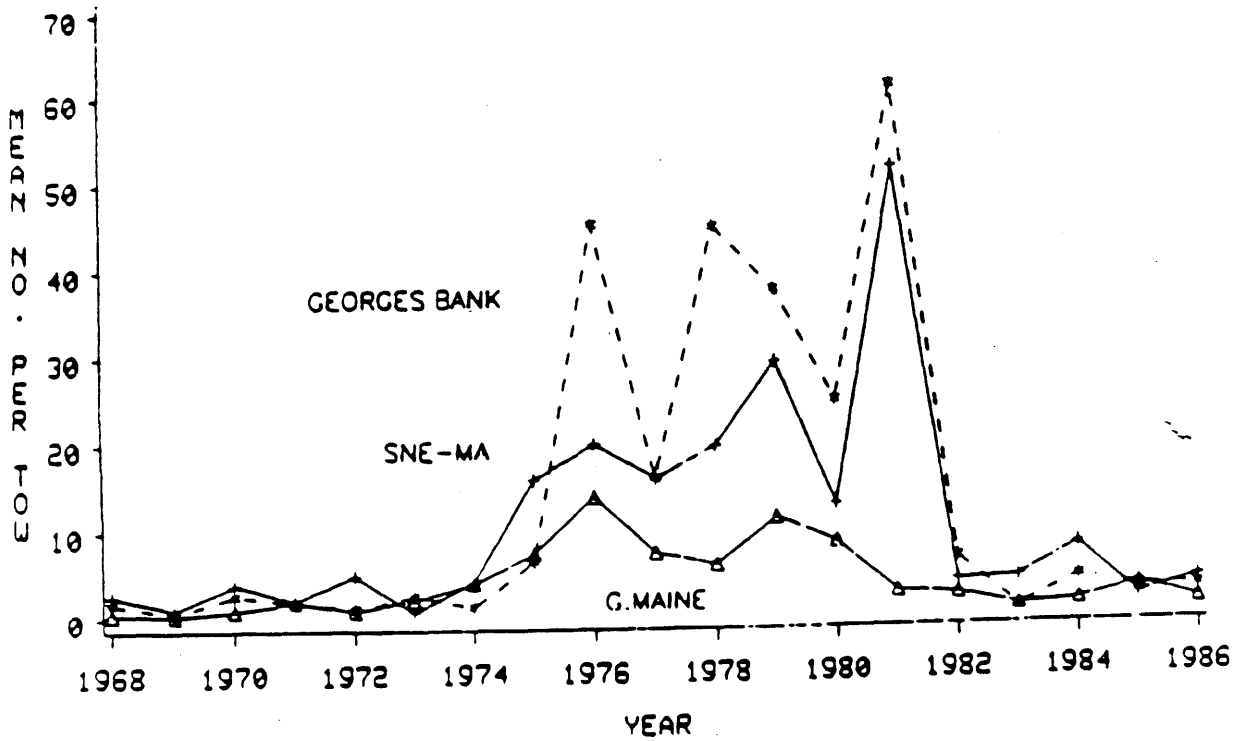


Figure II.4.3 Stratified mean number per tow of short-finned squid from the NEFC autumn bottom trawl surveys, by area (Southern New England - Mid-Atlantic, Georges Bank and Gulf of Maine), 1968-86.

5. SCUP

Source Document: R.K. Mayo, 1982. An Assessment of the Scup, Stenotomus chrysops (L.), population in the Southern New England and Mid- Atlantic regions. NMFS, NEFC, Woods Hole Lab Ref. Doc. No. 82-46, 59 pp.

Fishery Landings

Commercial landings in Southern New England declined from 18-22 thousand metric tons in the 1960's to 4 thousand metric tons in the early 70's (Figure II.5.1). Since 1974, they have been stable at 6-10 thousand metric tons. Landings in the Mid-Atlantic also declined in the early 1970's from 5 thousand metric tons to less than 1000 metric tons in the 1970's; they have remained at this low level. The recreational catch also declined from 7500 metric tons in 1960 to 2800 metric tons in 1974, and remained fairly stable at 1.5 to 4 thousand metric tons. CPUE (mt/trawler day) for Southern New England has also been stable for the last ten years (Figure II.5.2).

Stock Abundance

The NMFS autumn inshore survey for Southern New England (strata 1-11, 45-55) was examined as an independent measure of age zero production and adult stock biomass. The geometric mean of stratum catches, expanded by the number of tows made, was used as the best measure of annual relative abundance (Table II.5.1). The index of age zero biomass (<12 cm length) varied from 0.2 to 6.3 from 1974 to 1986 showing strong production in 1977, 1978, and 1984. Very similar trends were seen in the age zero catch in the Rhode Island trawl survey (Narragansett Bay to Block Island Sound) from 1979-1986 (Table II.5.1). The Massachusetts (MA) survey of inshore state waters also showed a strong year class in 1984 but had higher estimates for the 1982 and 1983 year classes. The MA survey also showed a strong year class in 1978 similar to that of the NMFS data that year. The adult biomass index from NMFS surveys (Age 2+, 19cm and greater) ranged from 0.7 to 2.1 kg/strata from 1974-1985 without trends. The 1986 index of 0.1 is the lowest in the 14 year time series. The Rhode Island (RI) survey also showed a poor 1986 index, the lowest since 1979. However, there was no significant correlation between NMFS and RI indices for the eight years of common data. Adult biomass indices generated from the MA survey also showed no correlation with either the NMFS or RI surveys. The MA survey indicated 1986 was average in adult biomass. The Connecticut (CT) survey in Long Island Sound also showed 1986 adult biomass to be higher than 1984 or 1985.

Estimates of total mortality from catch curve analysis of age frequencies from the MA survey catches in 1984-1986 and CT survey catches in 1983-1985 were 0.59 and 0.64 respectively. These estimates are higher than the value of 0.50 reported by Mayo in 1980.

A yield per recruit model was constructed using the following assumptions:

1. Each year was divided into two 6 month seasons; a winter season when only the offshore fishery operates and the fish increase in weight from the observed November weight to the observed April weight for their age; and a summer season when only the near shore commercial and sport fishery operate, and fish increase from their observed May weight to the observed October weight for their age.

2. The age at full recruitment for the two commercial fisheries was age 3, with 50% recruitment at age 2; full recruitment for the sport fishery was age 2, with 10% recruitment at age 1. These recruitment levels correspond to observed age frequencies in the CT sport and commercial fisheries. The offshore fishery was assumed to recruit scup in the same manner as the inshore fishery.

3. Natural mortality was considered constant at 0.20. Fishing mortality was divided among the three fisheries with 22 % attributed to the recreational fishery, 43 % to the inshore commercial fishery, and 35 % to the offshore winter commercial fishery. These divisions correspond to the ratio of landings reported by the NMFS landing statistics from 1972-82, as well as the ratio of tag returns in the CT scup tagging program conducted in 1980-82.

Under present recruitment conditions, Fmax equals 0.38, near the estimated present F value (Figure II.5.3). If fishing is restricted to age 2 and older, Fmax increases to 0.40 and yield-per-recruit increases only slightly (1.3%). Moving recruitment to age 3 increases F_{max} to 0.62 and increases yield-per-recruit 14%. Such a scenario would require a universal 10 inch length limit throughout the range of the stock. At present recruitment levels, a fishing rate of F= 0.38 results in a SSB/R of 14% the size of the fished stock, while F=0.50 yields an SSB/R of 10%. (Figure II.5.4).

Spawn and Recruit Relationship

The NMFS autumn inshore southern New England survey and MA survey data were examined for a relationship between age zero and adult biomass indices each year, using a Ricker function (Figures II.5.5 and II.5.6). Both surveys showed a peak in zero-class production corresponding to parent stock levels between 0.8 and 1.2 kg per tow biomass. Age zero-class biomass was lower for parent stock greater and lower than these levels. Both surveys showed a marked decline in recruitment biomass for stocks below 0.4 kg per tow.

Summary

Commercial landings and CPUE for southern New England and the recreational catch has remained stable since 1970, and landings from the Mid-Atlantic have also been stable but low. Based on NMFS bottom trawl surveys, adult biomass indices ranged from 0.7 - 2.1 kg/strata from 1974 - 1985 without any temporal trend. For years of comparable data, no correlation exists in the adult indices between NMFS, MA and RI surveys. The 1986 NMFS and RI indices were very low although the MA and CT indices were at least average. For age 0 indices, there was more consistency among surveys. Relatively strong year-classes occurred in 1977, 1978, and 1984. In 1982 and 1983 the MA age 0 indices were also strong.

Total mortality estimates derived by catch curve analysis were 0.59 and 0.64 from 1984-1986 MA and 1983-1985 CT age-frequencies, respectively. Total mortality values were higher than the 0.50 reported by Mayo in 1980. A yield-per-recruit (Y/R) analysis showed for present recruitment rates to the fishery Fm_{ax} = 0.38 and SSB/R equal to 14% the size of an unfished stock. A relationship between age zero and adult biomass indices was derived from NMFS and MA survey data using a Ricker function. Both surveys showed peak production corresponding to parent stock levels between 0.8 and 1.2 kg/stratum.

Discussion

Prior to early 1960's, Virginia (VA) commercial landings represented a larger segment of the overall fishery. Southern New England landings also declined but have recovered. Recent increased landings from the RI fish traps have been offset by declines in the RI trawl fishery. Because scup seem to be still inshore in October, the NMFS autumn survey may not adequately sample the population except for inshore strata. As noted only the inshore strata were used in the analysis.

A conservative management option might entail advancing recruitment up to age 3. Based on the Y/R analysis this would increase F_{max} to 0.62 and increase Y/R to 14%. Such a scenario would require a universal 10" length limit, which would probably be unacceptable to the recreational fishery. It would also require the use of 4.5 - 5" cod end mesh for the trawl fishery. If fishing is restricted to age 2 and older, F_{max} increases to 0.40 but Y/R increases only slightly (1.3%). An inconsistency was noticed in NOAA (1986). On page 68 the size at 50% maturity is stated to equal 21 cm (9") yet on page 66 it states that "Sexual maturity is essentially complete by age 2 at a total length of 21 cm (8")...".

The long-term potential catch is listed as 10,000 - 15,000 MT per year in NOAA (1986) with F now at about F_{max}. Possible yield depends on how far beyond the current F_{max} the fishery might operate at if the age at recruitment was changed such that fish were not caught until age 3. A "fully exploited" stock depends on the benchmarks that are used. Presently, the stock is not at optimum size. If it was, catches would be higher.

It was discussed if management should consider how to reach the long-term potential of the stock or is that not possible to reach? Stock rebuilding could be initiated. If fishing mortality were reduced, subsequently, F might be increased. Given the existing F, the stock appears to be fully exploited. It was asked if VA trawlers are still fishing for scup. No one responded, but it was noted that the NMFS index of age 1 fish was relatively high. It was suggested that other factors could be examined to reduce the variability in the various survey indices, (e.g., temperature). The MA survey is conducted virtually during the same time period each year. It was stated that it is particularly difficult to assess scup abundance with precision with trawl surveys because (1) scup are frequently located on hard (untrawlable) bottom, particularly during the spawning season, (2) they are a schooling species, and (3) they exhibit diel behavior which appears not always to be consistent.

Fishing is often best from twilight to midnight or 2 A.M., when fish are concentrated near the bottom. The state surveys are only conducted during daylight whereas NMFS surveys are done around the clock. It was pointed out that a CT study found that only 8% variability in scup survey catch could be attributed to the following factors: month (6.4%), bottom type (1.8%), and depth (0.0%). Until scup reach sexual maturity, most of the growth occurs from spring through September or October. Therefore, one-year-olds may recruit to late-season recreational or inshore commercial fisheries.

Table II.5.1. Geometric Wt/Tow of Scup by Age Class for Three Surveys

	NMFS AUTUMN INSHORE			MA AUTUMN			RI AUTUMN		
Year	Zero	One	Adult	Zero	One	Adult	Zero	One	Adult
74	0.4	1.0	0.7						
75	0.8	1.1	2.1						
76	0.2	1.3	1.0						
77	2.5	0.4	1.0						
78	2.2	0.7	0.9	9.2	1.0	0.9			
79	0.4	0.5	1.0				0.8	2.3	1.0
80	1.5	1.6	0.5				7.4	15.6	4.4
81	0.6	1.2	1.2				36.8	32.5	3.8
82	0.7	1.6	1.5	7.6	1.2	0.6	13.8	3.3	1.0
83	1.9	0.7	0.7	7.1	1.7	1.0	27.9	13.4	1.1
84	6.3	2.0	0.9	5.7	1.4	0.5	92.4	43.9	5.4
85	0.4	1.3	1.5	3.2	2.2	1.9	13.1	5.2	1.5
86	0.9	0.01	0.1	3.8	1.5	1.2	28.9	28.6	0.6

Sum of catch by stratum logged-geo mean taken

Weighted arithmetic mean catch by stratum logged-geo. mean taken

Sum of catch by stratum logged-geo. mean taken

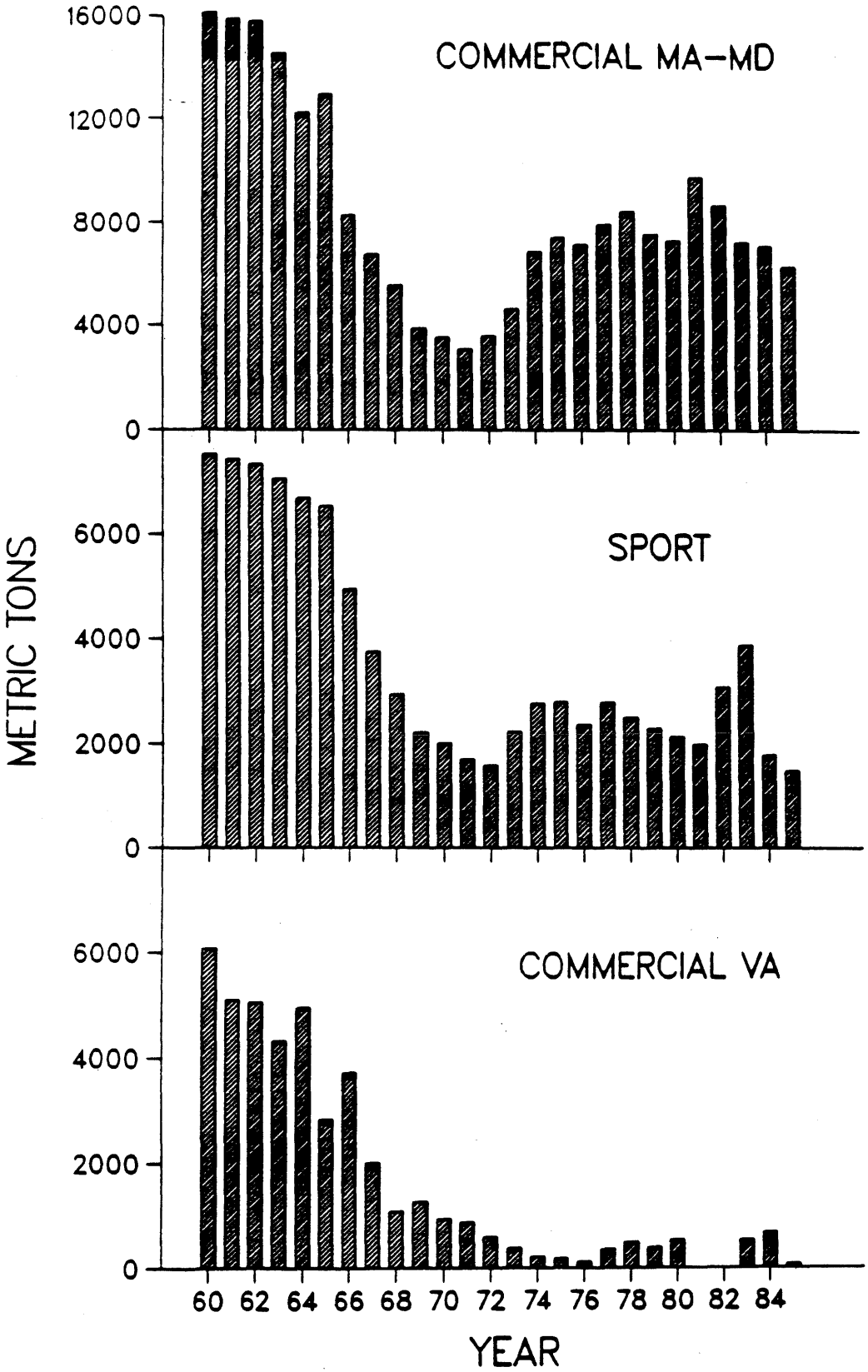


Figure II.5.1. Commercial and recreational landings of scup with the commercial shown separately for the Massachusetts to Maryland region and for Virginia.

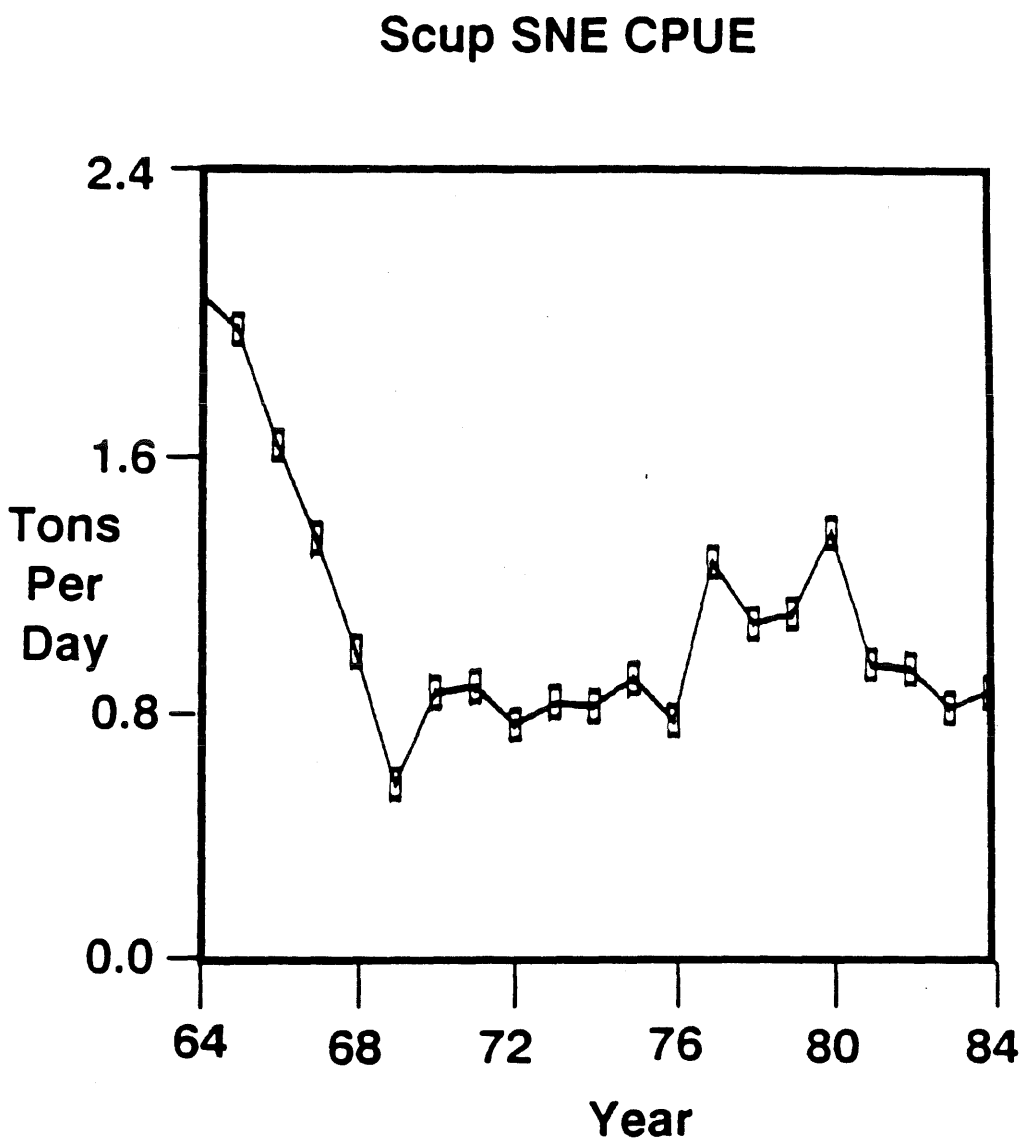


Figure II.5.2. Catch per unit of effort for scup in southern New England over time.

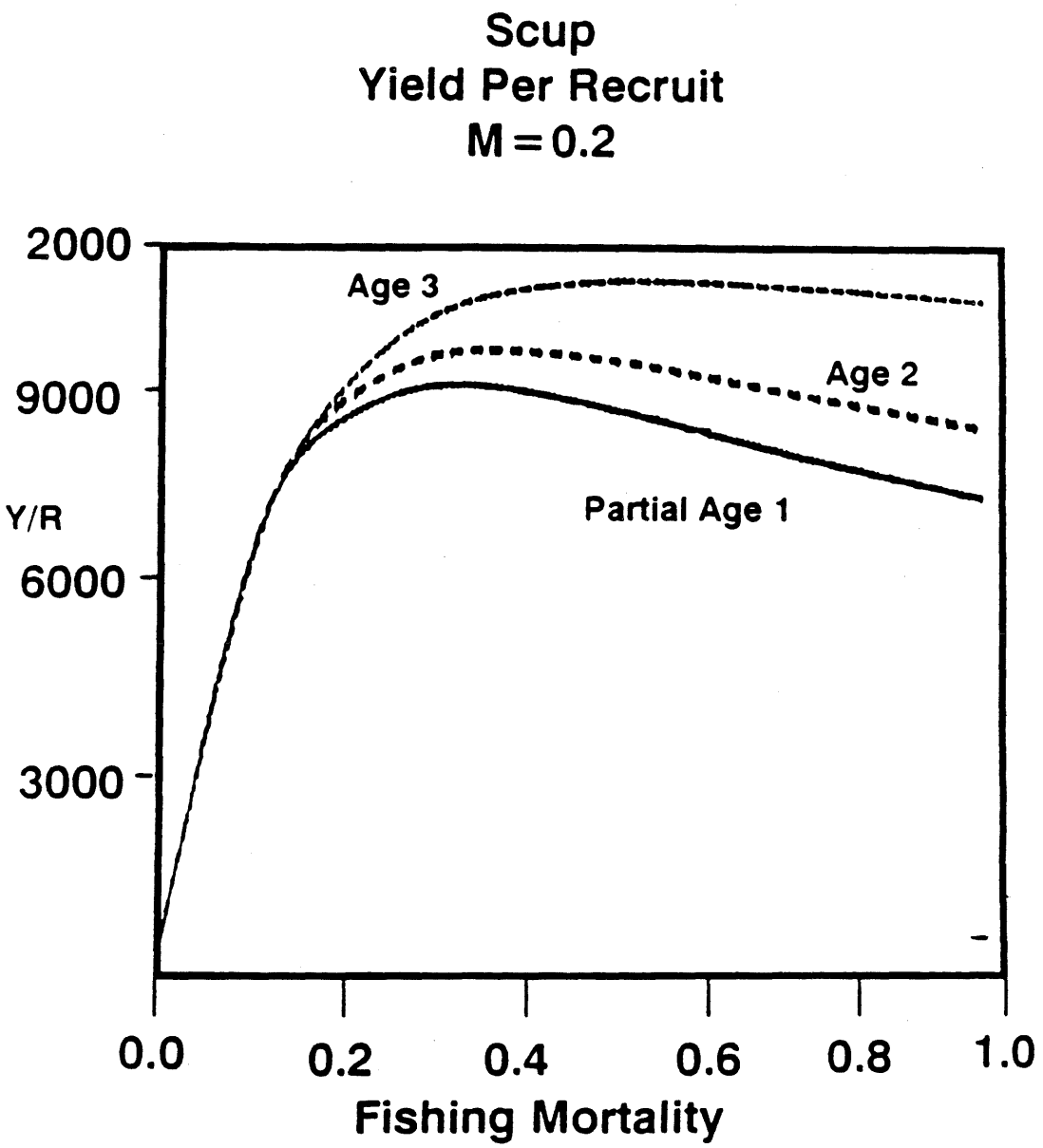


Figure II.5.3. Yield per recruit for scup as a function of varying fishing mortality rates, for partial recruitment at age 1, 2, and 3, separately.

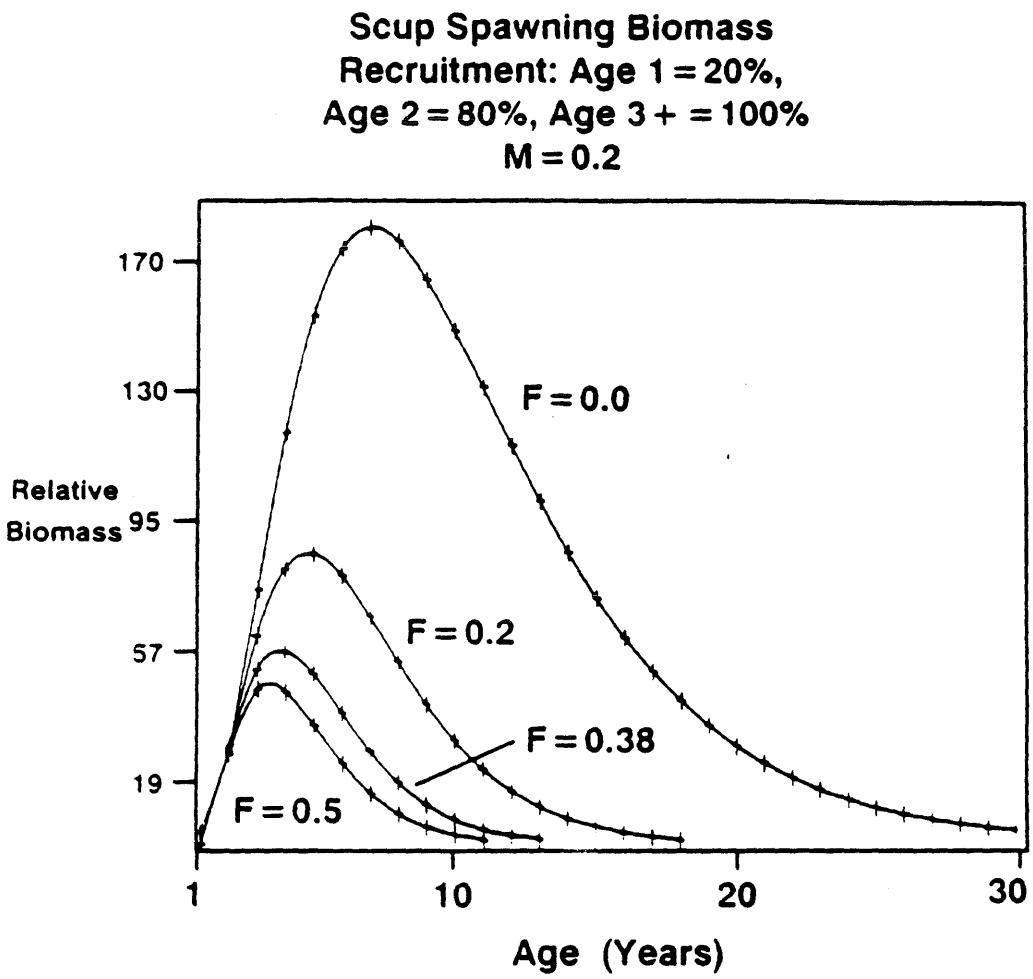


Figure II.5.4. Relative spawning biomass of scup at different ages for fishing mortality ranging from 0 to 0.5.

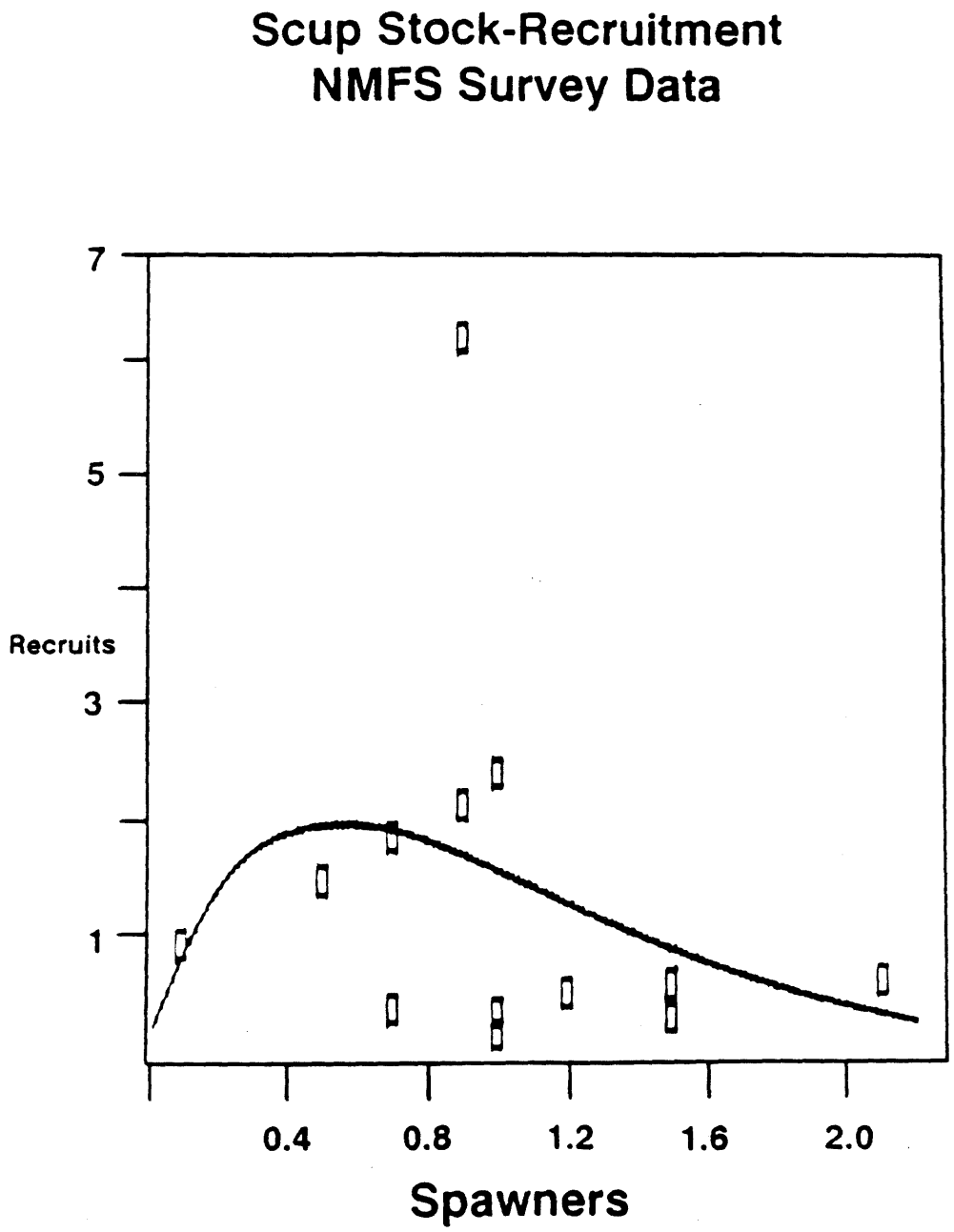


Figure II.5.5. Recruitment as a function of spawning stock biomass for scup, based on NEFC trawl survey data.

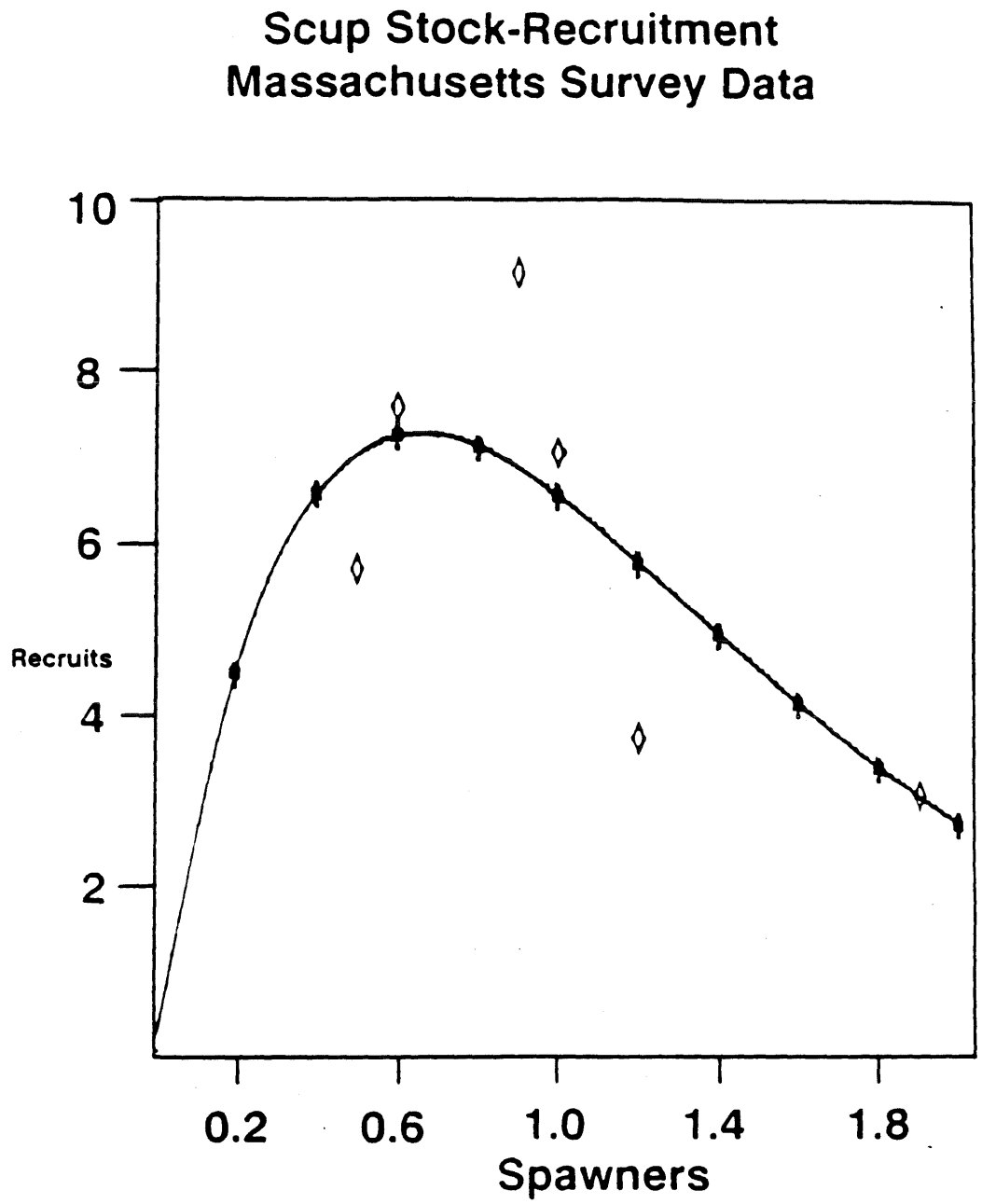


Figure II.5.6. Recruitment as a function of spawning stock biomass for scup, based on MA trawl survey data.

III. REVIEW OF NEW ENGLAND FISHERY RESOURCES

1. SILVER HAKE

Source Document: Almeida, F.P. 1987. Status of the Silver Hake Resource off the Northeast Coast of the United States - 1987. NMFS,NEFC, Woods Hole Lab. Ref. Doc. No. 87-03.

Gulf of Maine - Northern Georges Bank Stock

Summary

Total nominal catches from this stock were 8,359 mt in 1986, a slight increase over 1985 and continuing an increasing trend since 1979. The catch was taken exclusively by the USA. The NEFC spring and autumn bottom trawl survey catch-per-tow indices indicate general increasing trends, from low levels recorded in the early 1980's, with the 1986 levels among the highest in the series. Total stock biomass at the beginning of 1987 from VPA was estimated to be 69,000 mt, a slight decrease from 1986, but a threefold increase over a record low level in 1980. Spawning stock biomass was estimated to be 34,000 mt, a 55% increase over 1986, and also a threefold increase over the record low in 1981. Recruitment in 1986 was estimated to be about 230 million fish, the highest level since the 1973 cohort. Assuming a recruitment of 120 million fish in 1987, a catch of 10,700 mt could be taken in 1987 while maintaining a constant stock size from 1987 to 1988. Fishing at $F_{0.1}$ in 1987 would produce a catch of about 14,300 mt and would reduce age 2+ stock size in 1988 by about 8%.

Southern Georges Bank - Middle Atlantic Stock

Summary

Total international catch in 1986 was 10,052 mt, a 25% decrease from 1985 and continuing the low level of reported catches since about 1980. The USA commercial catch was 9,408 mt, the lowest level since 1975, and a 21% drop from the 1980-1985 average. Recreational catch in 1986 was estimated to be approximately 94 mt. The distant water fleet reported catches of 550 mt in 1986, with landings from Italy, Japan, Spain, and the German Democratic Republic. Bottom trawl survey indices have indicated an increase in abundance in this stock since the early 1980's. Total stock biomass at the beginning of 1987 was estimated to be 58,000 mt, a 6% increase over 1986 and a 26% increase over a record low estimate for 1981. Spawning stock biomass was estimated to be about 35,000 mt in 1987. This level represents an 11% increase over 1986, and a 46% increase over a record low estimate for 1983. Recruitment was estimated to be about 200 million fish in both 1986 and 1987. Assuming this level of recruitment, a catch of about 12,600 mt could be taken in 1987 with no change in age 2+ stock size from 1987-1988. Fishing at $F_{0.1}$ in 1987 would produce a catch of about 11,500 mt and would result in a 2% increase in stock size from 1987 to 1988.

Discussion

The revised assessment of silver hake was presented in response to evaluation of a previous assessment at the 2nd SAW. Since that review, several items of concern had been addressed for the new two stock groupings:

1) The use of relative exploitation indices (total international catch divided by NEFC survey index) in tuning the VPA was evaluated and found to be satisfactory.
2) The F's of early seventies following re-calculation of catch-at-age matrix and subsequent VPA were evaluated. Unexpectedly high estimates of F's in the 1970's were found to be due to changes in exploitation pattern caused by foreign fisheries.
3) Aging technique changes were evaluated and found to have had no effect on the estimated catches at age.
4) Age groups in the VPA were truncated from 12 to 9+ years.
5) New survey indices were calculated incorporating an intervention model to account for gear changes during the survey.
6) An ARIMA time series model was used to fit the survey data resulting in the smoothing of large inter-annual variations seen in the survey samples.

Assessment of the Gulf of Maine-Northern Georges Bank stock was presented and the variability seen in mean weights at age, particularly for later years was questioned. This was due to sampling deficiencies in certain age groups. A recommendation was made to exclude 0's and 1's in calculating the relative exploitation index because those are pre-recruit fish. The allocation of foreign catches to the correct stock areas was discussed and an explanation given about the limitations of using Coast Guard over-flight data in making the re-allocations, as well as problems of correctly identifying vessels fishing for silver hake.

Assessment data were presented for the Southern Georges Bank - Middle Atlantic stock with no discussion specific for that area. There was general discussion relative to the presence of large year classes in the early 1960's, similar to haddock. There is little likelihood of such large cohorts in the near future given the current age structure of the population and the age composition of catches during the 1970's and 1980's. The point was also raised that M for this species may vary under heavy fishing due to the elimination of older fish that tend to cannibalize young individuals.

2. 1985 GEORGES BANK HADDOCK YEAR CLASS

The 1985 year class of haddock on Georges Bank appeared to be a relatively strong cohort based on the results of the 1985 Autumn bottom trawl survey. Subsequently, in the spring and autumn of 1986, surveys have shown that this cohort is much smaller. The mean catch per tow in the autumn 1986 survey was 5.20 suggesting that the 1985 cohort is about equal in magnitude to the 1972 year class, which totaled about 14 million fish at age 2. The predicted size

for the 1985 cohort would be 9.6 million fish. The 1984 and 1986 year classes appear to be two of the smallest on record.

Approximate 95% confidence intervals for the size of the 1985 year class were calculated. These suggest a lower bound of about 1.3 million fish and an upper bound of about 21.2 million. Point estimates for the 1984 and 1986 year classes suggest that they are about 1.2 million and 40,000 fish respectively. These estimates were used in forecasts to project catches and spawning stocks up to 1991. If the 1985 mean is used, then about one year of slightly increased catch will result in 1987. If the 1985 upper bound is used, then improved catches will result in 1987 and 1988 under present F levels.

Discussion

Discussion focused on possible management options that would increase spawning stock biomass. Haddock grow relatively rapidly so that if F were substantially reduced below the current level of 0.5, biomass would begin to accumulate even if recruitment remains poor. Rebuilding would occur fairly quickly if a strong year class recruits to the fishery. An increase in mesh size or minimum size would also result in an accumulation of spawning stock biomass. It was suggested that the incremental effect of small percentage increases of a series of better-than-average year classes (e.g., the 1985 year class) might provide new biomass more effectively than infrequent recruitment by very strong year classes.

3. AMERICAN PLAICE (DAB)

Source Document: NEFC. 1986. Report of the Second Stock Assessment Workshop (SAW). NMFS, NEFC, Woods Hole Lab. Ref. Doc. 86-09, pp 61-71.

Trends in landings

Landings of Gulf of Maine American plaice have dropped sharply in recent years, from historical peaks of around 11,000 mt in 1980-1982 to 3,300 mt in 1986 (Table III.3.1, Figure III.3.1). Historically, landings from the Gulf of Maine had been minor, averaging 800 mt between 1960-1974. In 1975 landings began a pattern of steady increase to 1980-1982 levels, before a recent downturn.

Landings from the Georges Bank area have shown similar overall patterns but not as wide fluctuations over time as those from the Gulf of Maine. USA landings have dropped from historically high levels of around 4,000 mt in 1982-1983 to around 1,150 mt in 1986, the lowest level since 1976. Before that, USA landings from 1960-1974 averaged 1,700 mt, with higher levels between 1964-1970.

The American plaice fishery has been dominated by USA commercial catches. The Canadian commercial component has been minor and fairly stable over time, primarily prosecuted in the Georges Bank region. Commercial catches by other

nations, primarily the USSR, occurred between 1965-1977. The otter trawl is the principal gear in the fishery. There is no significant recreational component to this offshore fishery.

Size composition of landings

American plaice are landed in six market categories: unclassified, jumbo, large, medium, small, and pee-wee. In 1986, fish in the pee-wee category ranged from 28-40 cm (total length); fish in the small category were generally between 31-45 cm; fish in the medium category ranged between 33-47 cm; fish in the large and jumbo categories were generally over 40 cm. A 30 cm fish is approximately 4 years old (Sullivan 1982) and approximately 33% are mature at that length (Morse 1979).

The fraction of small fish in the landings from the Gulf of Maine appears to be increasing from 16-22% in 1975-1977 to 26-31% in 1978-1981. With the addition of pee-wee and medium categories in 1982, small/pee-wee fish contributed at least 22 % of area landings, and up to 26-40% if all medium landings could be combined with the small/pee-wee category. In 1986, small/pee-wee categories contributed 28% of area landings and medium/small/pee-wee combined contributed 50%. In the Georges Bank region the fraction of small/pee-wee fish has fluctuated at between 27-35% of the total area landings; combining all medium landings would increase that fraction to up to maxima of 40-48% in 1982-1984. In 1986, small/pee-wee categories contributed 30% of area landings, and medium/small/pee-wee categories contributed 39%.

Commercial catch and effort

In recent years, average vessel tonnage and effort (in terms of both number of trips and days fished) in the fishery has increased (Tables III.3.2-4). In the Gulf of Maine, landings by vessel class 3 and, most recently, by vessel class 4 have increased relative to tonnage class 2. On Georges Bank, a greater percentage of landings are being made by vessel class 4 relative to vessel class 3 (Table III.3.2). Effort by tonnage class 2 vessels in the Gulf of Maine reached high levels in 1982; effort by tonnage class 3 and 4 vessels reached record high levels in 1986 (Table III.3.3). Overall, total effort (catching any American plaice) has tripled since the early 1970's. On Georges Bank, effort by ton class 2 vessels peaked in 1981; effort (as days fished) by ton class 3 and 4 vessels peaked in 1985-1986 but declined 20-30% in 1986 to the levels of the late 1970's, in the case of ton class 3 vessels, and to 1982 levels in the case of ton class 4 vessels (Table III.3.4).

The earlier trend toward a more directed fishery in the Gulf of Maine has reversed substantially in 1985-1986 (Table III.3.5). The percentage of landings derived from directed trips (trips in which 50% or more of the catch weight consisted of plaice) increased in the Gulf of Maine from the mid-70's to 1981. At that point, nearly 70% of plaice landings came from directed trips. Since then, the fraction of landings from directed trips has declined to 8% overall. On Georges Bank, between 20-30% of landings from 1964-1970 could be categorized as from directed trips. Most plaice were landed as "by-catch" from 1972-1980. A more directed fishery appeared between 1981-1984, but 1985-1986 landings again resumed the "by-catch" pattern (Table III.3.5).

Directed CPUE indices are at or near historical low levels for all tonnage classes in the Gulf of Maine (Table III.3. 6, Figure III.3.2). CPUE by ton class 2 and 3 vessels has declined from peaks in 1977 and 1979 of 2.46 and 3.22 mt/day fished, to 0.77 and 1.02 mt/day fished, respectively. For Georges Bank, ton class 3 provide the most consistent and sizeable effort over the analysis period (Table III.3.7). CPUE in that case was steady or slightly increased from 1971 to 1982, when the index reached 2.29 mt/day fished (Figure III.3.3). Since 1982, it has dropped to 0.56 mt/day fished in 1986.

Research vessel survey indices

Trends in abundance based on NEFC offshore survey indices are consistent with those observed in the commercial CPUE time series. In the Gulf of Maine, relative abundance in the mid-70's was low compared to the late 60's and late 70's - early 80's. Recently, there has been a sizeable decline from peak indices of 11.0 kg/tow (autumn index) in 1978 and 1980 to 2.6 kg/tow in 1986, comparable to the low indices of the mid 70's (Table III.3.8, Figure III.3.4).

On Georges Bank, the declining trend from early 60's to early 70's and increasing trend from mid 70's to early 80's is present in both commercial and research index series. The autumn survey index reached a maximum in 1980 (3.2 kg/tow) and declined to the second lowest level observed by 1986 (0.4 kg/tow). The spring survey index peaked in 1982 (4.0 kg/tow) and declined rapidly to historically low levels in 1986 (0.50 kg/tow) (Table III.3.8, Figure III.3.4).

Summary

Commercial CPUE indices and research survey abundance indices have declined from near record high levels in the early 1980's to near record low levels in 1986. Total landings have declined rapidly from peak levels. Stock abundance will decline until strong new year classes recruit.

Discussion

The presentation on the status of American plaice followed the draft text. Landings of American plaice in the Gulf of Maine dropped sharply from historical peaks of around 11,000 mt in 1980-1982 to 3,300 mt in 1986, while landings from the Georges Bank area dropped from 4,000 mt in 1982-1983 to 1,150 mt in 1986. Trends in abundance based on the NEFC offshore survey indices are consistent with those observed in the commercial CPUE time series which also declined precipitously from high levels in the early 1980's to near record low levels in 1986. Landings and CPUE in 1987 are expected to drop further.

A concern was raised about the use of the definition of directed effort of those trips with greater than 50% of American plaice in the total trip landings. Lower values of 10-20% were suggested. There was also some discussion concerning American plaice in the by-catch in the shrimp fishery. It was suggested that cycles in American plaice abundance be compared with intensity of shrimp fishing.

Additional information on an American plaice pre-recruit index was presented based on Massachusetts Division of Marine Fisheries (DMF) surveys conducted in May and September in five regions and is included in details below. In summary, age 1 and age 2 fish were identified from length frequency analysis with the index based specifically on the number of age 2 fish caught during the spring DMF survey from 1978-1986. Given a four year lag, low index values for 1980-1983 suggest the low landings obtained in 1986 and expected in 1987. An above-average index for 1984 implies an improvement in landings for 1988.

The absence of a reliable pre recruit index for American plaice was designated during the first stock assessment workshop as an important assessment issue. Although the associated issue of stock structure remains unresolved, Massachusetts Division of Marine Fisheries (DMF) bottom trawl surveys may provide important input to a pre-recruit index for Gulf of Maine American plaice.

During May and September surveys, American plaice are an important component of the catch. Characteristically, more than 95% of of the catch is from Massachusetts and Cape Cod Bays (Figure III.3.6), and 90% of these are pre-recruits (<30 cm). In May, American plaice have consistently ranked first or second in number/tow for Massachusetts Bay and within the top five or six in Cape Cod Bay.

Trends of abundance based on DMF spring survey biomass indices (Figure III.3.7) parallel NEFC biomass indices. However, NEFC weight indices are twice those of DMF indices while DMF number indices are approximately twice those of NEFC. Since DMF surveys sample smaller individuals, they appear to be more suited to judge year-class strength at a younger age.

Although age data have not been included in this pre-recruit analysis, spring length-frequency modes are well defined in most years, and correspond to other researchers' length-at-age determinations for one and two year old fish at 9 and 17 cm, respectively (Figure III.3.8). The pre-recruit index was based on age 2 fish caught during spring DMF surveys from 1978-1986. Since all year classes were more abundant at age 2 than at age 1, age 2 fish were selected for analysis. Stratified mean number/tow at each length-frequency interval for Massachusetts Bay (13-21 cm) and Cape Cod Bay (13-23cm) were summed. The index was derived by using the difference from the 9-year mean for each year class at age 2.

Landings of American plaice from the Gulf of Maine have declined from a peak of 11,148 metric tons to 4,758 metric tons in 1985 (Figure III.3.9). If dab recruit to the commercial fishery at 30 cm or approximately age 4, then, since 1981, commercial landings for the Gulf of Maine follow the same trend as the pre-recruit index lagged by four years (Figure III.3.9). Although the landings are not only from one year class, there has been increased landing of the smaller market categories in recent years. In 1982, small and peewee (23-40 cm) market categories contributed at least 22% of the Gulf of Maine landings. The high percentage of smaller fish landed in 1982 coincides with the recruitment of the 1978 cohort, the strongest of the time series.

Because of decreasing year class indices beginning in 1978 and successive below-average cohorts in 1980-1983, landings might, at current levels of fishing mortality, be expected to decline or remain at present levels until 1988 when the above-average 1984 year class recruits to the fishery. Initial indications of the 1985 year class at age 1 are of continued good recruitment in 1989 (Figure III.3.10). The reliability of this pre-recruit index remains to be determined.

Table III.3.1. Commercial catch (metric tons) of American plaice from the Gulf of Maine, Georges Bank-Southern New England and Mid-Atlantic regions. 1982 - 1986.

	Gulf of Maine			Georges Bank-Southern New England					Mid-Atlantic			GRAND TOTAL	
Year	USA	Canada	Total	USA	Canada	USSR	Other	Total	USA	Other	Total	USA	Total
1982	11,148	-	11,148	3,971	27	-	-	3,998	8	-	8	15,127	15,154
1983	9,137	7	9,144	4,018	30	-	-	4,048	5	-	5	13,160	13,197
1984	6,835[1]	2	6,837	3,293	6	-	-	3,299	7	-	7	10,135	10,143
1985	4,757	1	4,758	2,259	38	-	-	2,297	2	-	2	7,018	7,057
1986[2]	3,319	-	3,319	1,150	-	-	-	1,150	2	-	2	4,471	

[1] Includes 14 mt from 5NK.

[2] U.S. weighout data only.

Table III.3.2. Percentage distribution of USA commercial otter trawl landings (metric tons, live) of American plaice, by vessel tonnage class[1], from the Gulf of Maine (Area 5Y) and Georges Bank (Area 5Ze), 1982-1986

	Gulf of Maine (Area 5Y)				Georges Bank (Area 5Ze)			
Year	Class 2	Class 3	Class 4	Total	Class 2	Class 3	Class 4	Total
1982	57.9	34.1	8.0	100.0	5.0	70.4	24.6	100.0
1983	51.5	37.8	10.7	100.0	2.7	65.6	31.7	100.0
1984	46.5	41.7	11.8	100.0	4.6	64.4	31.0	100.0
1985	39.8	41.0	19.2	100.0	4.2	64.7	31.1	100.0
1986	38.2	42.6	19.2	100.0	2.9	61.9	35.2	100.0

[1] Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT

Table III.3.3. USA commercial vessel trips, days fished[1], and average days fished per trip, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150; Class 4: 151-500 GRT) for otter trawl trips landing American plaice from the Gulf of Maine (Area 5Y), 1982 - 1986. Data are also provided for otter trawl trips in which plaice formed 50% or more of the total trip catch, by weight (directed trip).

	Vessel Tonnage Class											
	Class 2			Class 3			Class 4			Totals		
Year	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip
						All Trips						
1982	6845	6172	0.90	2671	3976	1.49	423	1405	3.32	9939	11553	1.16
1983	6379	4965	0.78	2922	4354	1.49	414	1744	4.21	9715	11063	1.14
1984	6155	4932	0.80	3174	4774	1.50	395	1662	4.21	9724	11368	1.17
1985	5308	4410	0.83	3315	5672	1.71	643	2670	4.15	9266	12752	1.38
1986	3927	4209	1.07	3208	5847	1.82	704	3001	4.26	7839	13057	1.66
						> 50% Trips						
1982	1975	2112	1.07	411	551	1.34	7	11	1.57	2393	2674	1.12
1983	1408	1242	0.88	291	326	1.12	4	7	1.75	1703	1575	0.92
1984	1247	962	0.77	286	231	0.81	2	3	1.50	1535	1196	0.78
1985	817	562	0.69	103	106	1.03	3	6	2.00	923	674	0.73
1986	232	241	1.04	31	43	1.39	6	7	1.67	269	291	1.08

Table III.3.4. USA commercial vessel trips, days fished[1] and average days fished per trip, by vessel tonnage class (Class 2: 5-50 GRT; Class 3: 51-150 GRT; Class 4: 151-500 GRT) for otter trawl trips landing American plaice from Georges Bank (Area 5Ze), 1982 - 1986. Data are also presented for otter trawl trips in which plaice formed 50% or more of the total trip catch, by weight (directed trip).

	Vessel Tonnage Class											
	Class 2			Class 3			Class 4			Totals		
Year	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip	Total Trips	Days Fished	Days Fished Per Trip
					All trips							
1982	516	455	0.88	2350	6580	2.80	782	3018	3.86	3648	10053	2.76
1983	336	268	0.80	2001	5989	2.99	805	3214	3.99	3142	9471	3.01
1984	347	285	0.82	2245	7850	3.50	790	3495	4.42	3382	11630	3.44
1985	276	380	1.38	2169	7933	3.66	777	3432	4.42	3222	11745	3.64
1986	222	171	0.77	1491	5340	3.58	666	2802	4.21	2379	8313	3.49
					> 50% Trips							
1982	25	11	0.44	146	423	2.90	21	50	2.38	192	484	2.52
1983	4	1	0.25	132	445	3.37	19	51	2.68	155	497	3.21
1984	14	7	0.50	109	313	2.87	18	55	3.06	141	375	2.61
1985	7	6	0.86	45	152	3.38	20	46	2.29	72	204	2.83
1986	1	<1	0.20	37	123	3.32	8	27	3.38	46	150	3.26

[1] Days fished with trawl on bottom was derived by dividing hours fished with trawl on bottom by 24.0

Table III.3.5. Percentage, within vessel tonnage class[1], of vessel class American plaice landings (L)[2], vessel trips (T) and effort (DF)[3] of otter trawlers landing plaice from the Gulf of Maine (Area 5Y) and from Georges Bank (Area 520) in which plaice comprised 50% or more of trip catch weight (directed trip).

	Vessel Tonnage Class											
	Class 2			Class 3			Class 4			Total		
Year	L	T	DF	L	T	DF	L	T	DF	L	T	DF
						Gulf of Maine (Area 5Y)						
1982	59.2	28.9	34.2	29.7	15.4	13.9	2.8	1.7	0.8	44.6	24.1	23.1
1983	48.9	22.1	25.0	19.3	10.0	7.5	1.5	1.0	0.4	32.7	17.5	14.2
1984	41.1	20.3	19.5	14.3	9.0	4.8	2.0	0.5	0.2	25.3	15.8	10.5
1985	30.5	15.4	12.7	6.9	3.1	1.9	1.4	0.5	0.2	15.3	10.0	5.3
1986	16.3	5.9	5.7	0.3	1.0	0.7	0.9	0.8	0.2	7.9	3.4	2.2
						Georges Bank (Area 5Ze)						
1982	17.8	4.8	2.4	36.1	6.2	6.4	11.5	2.7	1.7	29.2	5.3	4.8
1983	3.8	1.2	0.4	29.6	6.6	7.4	7.5	2.4	1.6	21.9	4.9	5.2
1984	7.5	4.0	2.5	16.5	4.9	4.0	9.3	2.3	1.6	13.8	4.2	3.2
1985	4.4	2.5	2.1	7.2	2.1	1.9	5.0	2.6	1.3	6.4	8.4	1.8
1986	0.6	0.4	0.1	9.8	2.5	2.3	7.0	1.2	1.0	8.5	1.9	1.8

[1] Class 2: 5-50 GRT; Class 3: 51-150 GRT; 4: 151-500 GRT

[2] Metric tons, live weight.

[3] Effort is expressed as days fished with trawl on the bottom and derived from hours fished with trawl on bottom divided by 24.0.

Table III.3.6. USA commercial landings (L)[1], days fished (DF)[2], and landings per day fished (L/DF), by vessel tonnage class (Class 2:5-50 GRT; Class 3:51-150 GRT; Class 4:151-500 GRT), of American plaice for otter trawl trips catching plaice from the Gulf of Maine (Area 5Y), 1982-1986. Data are also provided for otter trawl trips in which plaice formed 50% or more of the total trip catch, by weight (directed trip).

	Vessel Tonnage Class											
	Class 2			Class 3			Class 4			Total		
Year	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF[3]
					All Trips							
1982	6316	6172	1.02	3722	3976	0.94	871	1405	0.62	10909	11553	0.96
1983	4368	4965	0.88	3200	4354	0.73	904	1744	0.52	8472	11063	0.78
1984	2951	4932	0.60	2647	4774	0.55	753	1662	0.45	6351	11368	0.56
1985	1765	4410	0.40	1814	5672	0.32	851	2670	0.32	4430	12752	0.35
1986	1135	4209	0.27	1265	5847	0.22	568	3001	0.19	2968	13057	0.23
					>50% Trips							
1982	3737	2112	1.77	1106	551	2.01	24	11	2.18	4867	2674	1.83
1983	2136	1242	1.72	618	326	1.90	14	7	2.00	2768	1575	1.76
1984	1213	962	1.26	378	231	1.64	15	3	5.00	1606	1196	1.38
1985	539	562	0.96	125	106	1.17	12	6	1.87	676	674	1.01
1986	185	241	0.77	44	43	1.02	5	7	0.70	234	291	0.81

[1] Metric tons, live weight.

[2] Days fished with trawl on bottom was derived by dividing hours fished with trawl on bottom by 24.0.

[3] Total landings per day fished was derived by weighing individual tonnage class landings rates by the percentage of total landings represented in each vessel class and summing the weighted landings rates over the three vessel class categories.

Table III.3.7. USA commercial landings (L)[1], days fished (DF)[2], and landings per day fished (L/DF), by vessel tonnage class (Class 2:5-50 GRT, Class 3:51-150 GRT; Class 4:151-500 GRT), of American plaice for otter trawl trips catching plaice from Georges Bank (Area 5Ze), 1982 - 1986. Data are also provided for otter trawl trips in which plaice formed 50% or more of the total trip catch, by weight (directed trip).

	Vessel Tonnage Class											
	Class 2			Class 3			Class 4			Total		
Year	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF	L	DF	L/DF
					All Trips							
1982	191	455	0.42	2684	6580	0.41	938	3018	0.31	3813	10053	0.39
1983	105	268	0.39	2538	5989	0.42	1228	3214	0.38	3871	9471	0.41
1984	147	285	0.52	2077	7850	0.26	1001	3495	0.29	3225	11630	0.28
1985	94	280	0.33	1446	7933	0.18	696	3432	0.20	2236	11645	0.19
1986	33	171	0.19	706	5340	0.13	401	2802	0.14	1140	8313	0.14
					>50% Trips							
1982	34	11	3.09	970	423	2.29	108	50	2.16	1112	484	2.30
1983	4	1	4.00	751	445	1.69	92	51	1.80	847	497	1.71
1984	11	7	1.57	342	313	1.09	93	55	1.69	446	375	1.23
1985	4	6	0.68	104	152	0.68	35	46	0.76	143	204	0.70
1986	<1	<1	2.0	69	123	0.56	28	27	1.06	97	150	0.70

[1] Metric tons, live weight.

[2] Days fished with trawl on bottom was derived by dividing hours fished with trawl on bottom by 24.0

Table III.3.8. Stratified mean catch per tow in numbers and weight (kgs) for American plaice from USA offshore spring and autumn bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 36-40), on Georges Bank (Strata 13-25), and for the combined Gulf of Maine-Georges Bank area, 1982 - 1986.

	Gulf of Maine				Georges Bank				Combined Gulf of Maine-Georges Bank			
	Spring[1]		Autumn		Spring[1]		Autumn		Spring[1]		Autumn	
Year	Nos.	Wt	Nos.	Wt.	Nos.	Wt.	Nos.	Wt.	Nos.	Wt.	Nos.	Wt.
1982	16.45	6.76	6.27	3.29	11.46	4.04	6.56	2.00	14.15	5.51	6.41	2.70
1983	27.42	7.31	15.94	5.28	4.42	1.94	3.73	1.58	16.82	4.83	10.31	3.57
1984	5.84	2.10	11.55	2.93	1.72	0.65	1.88	0.76	3.94	1.43	7.09	1.93
1985	7.54	2.83	11.03	3.18	1.98	0.83	2.38	0.70	4.98	1.91	7.04	2.04
1986	4.36	1.28	9.43	2.63	1.59	0.50	1.30	0.38	3.09	0.92	5.68	1.60

[1] Spring surveys, in 1973-1981, were accomplished with a "41 Yankee" trawl; spring surveys in other years were accomplished with a "36 Yankee" trawl. No adjustments have been made to the catch per tow data for these gear differences.

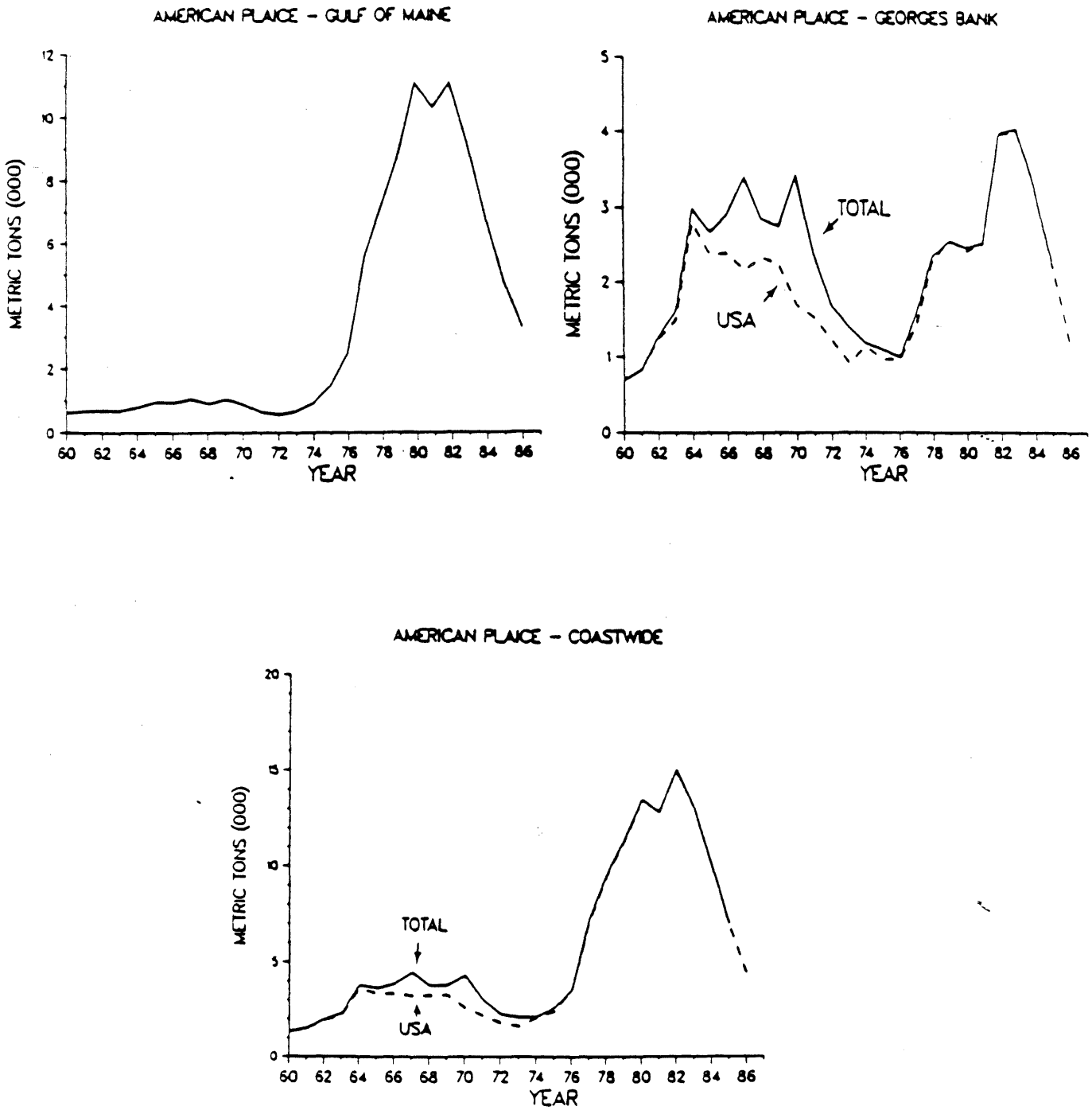
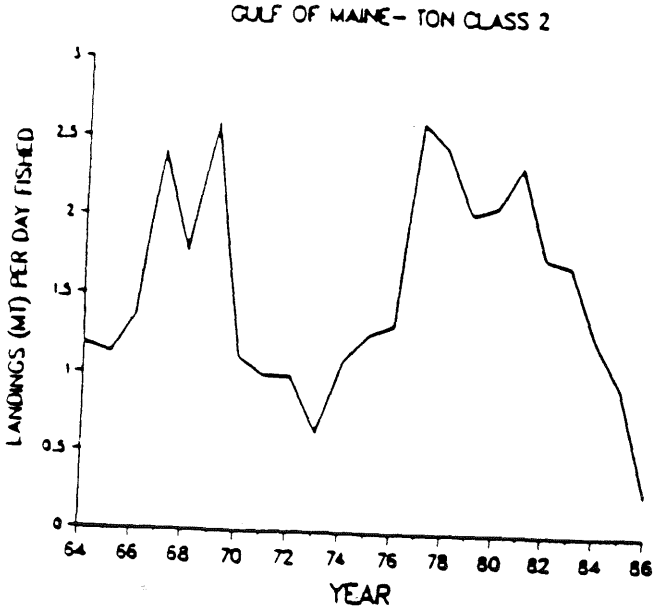
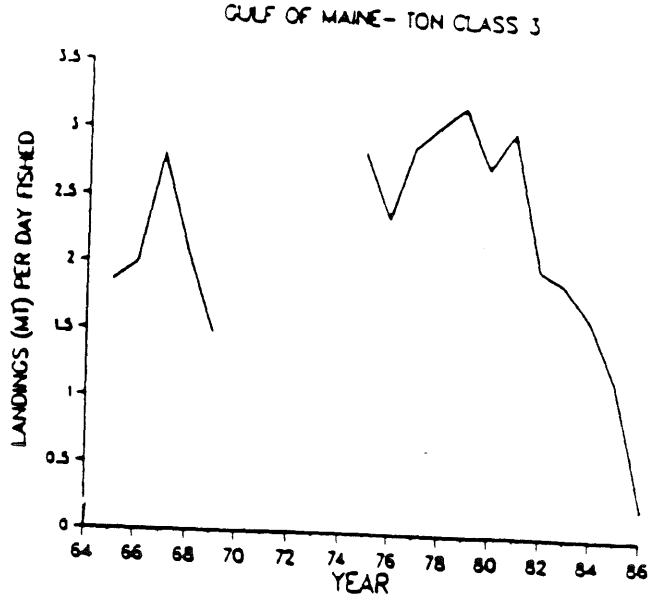


Figure III.3.1 Total commercial nominal catch of American plaice from Gulf of Maine (Area 5Y), Georges Bank (5ZE) and coastwide (Areas 5 and 6).





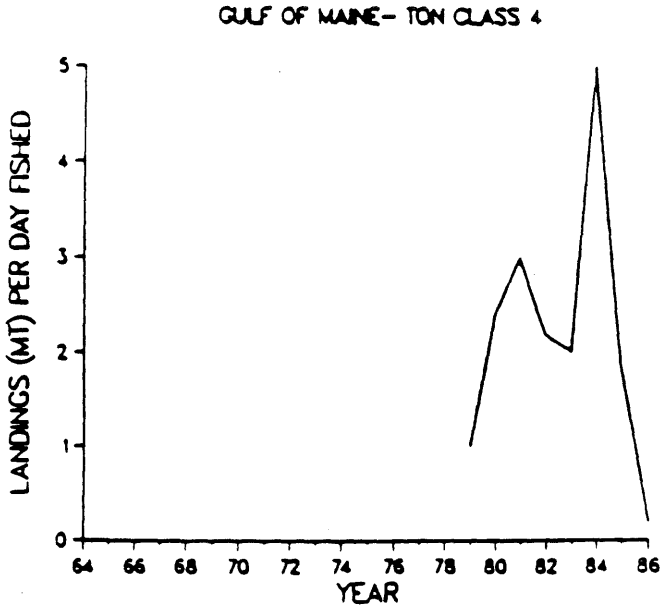
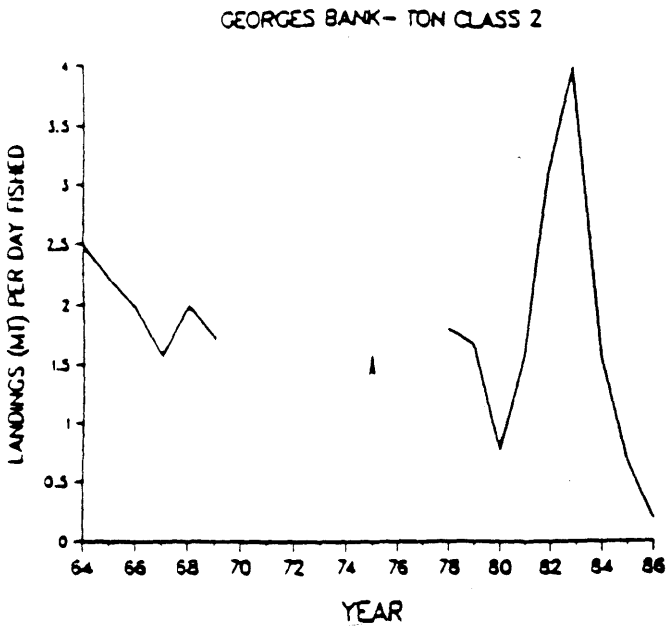
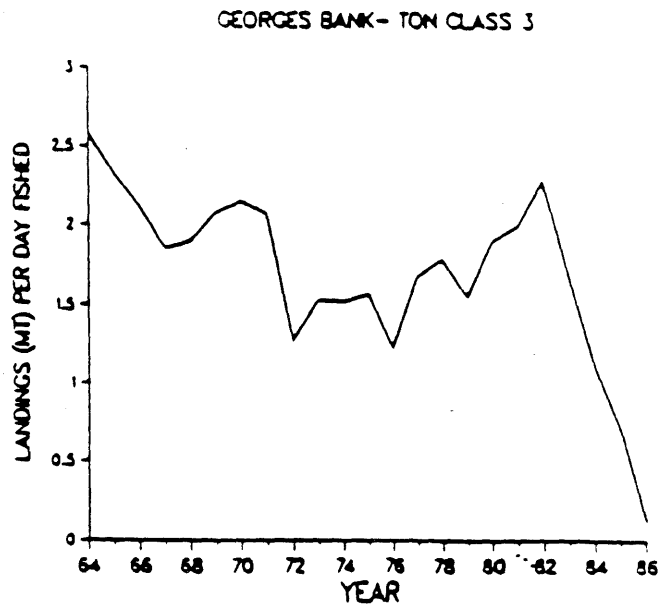


Figure III.3.2. Directed catch per unit effort by otter trawlers (based on trips in which plaice contributed 50% or more of total trip catch by weight) from the Gulf of Maine (Area 5Y).





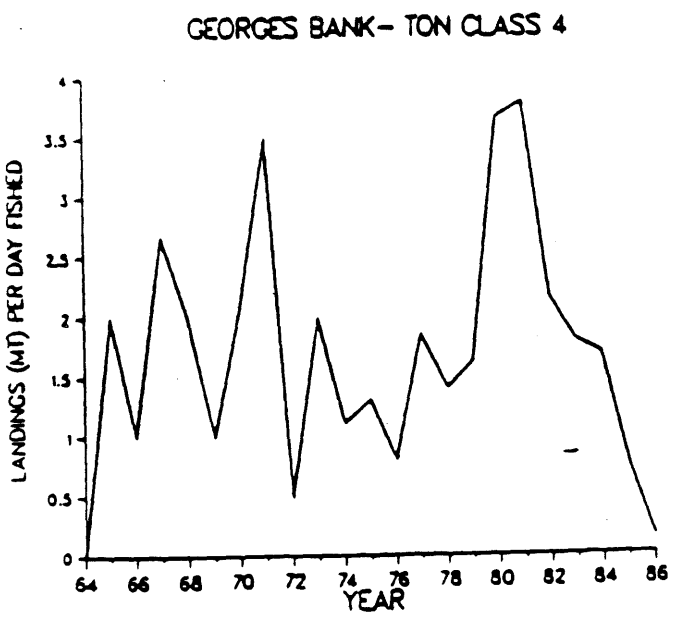


Figure III.3.3. Directed catch per unit effort by otter trawlers (based on trips in which plaice contributed 50% or more of total trip catch by weight) from Georges Bank (Area 5ZE).

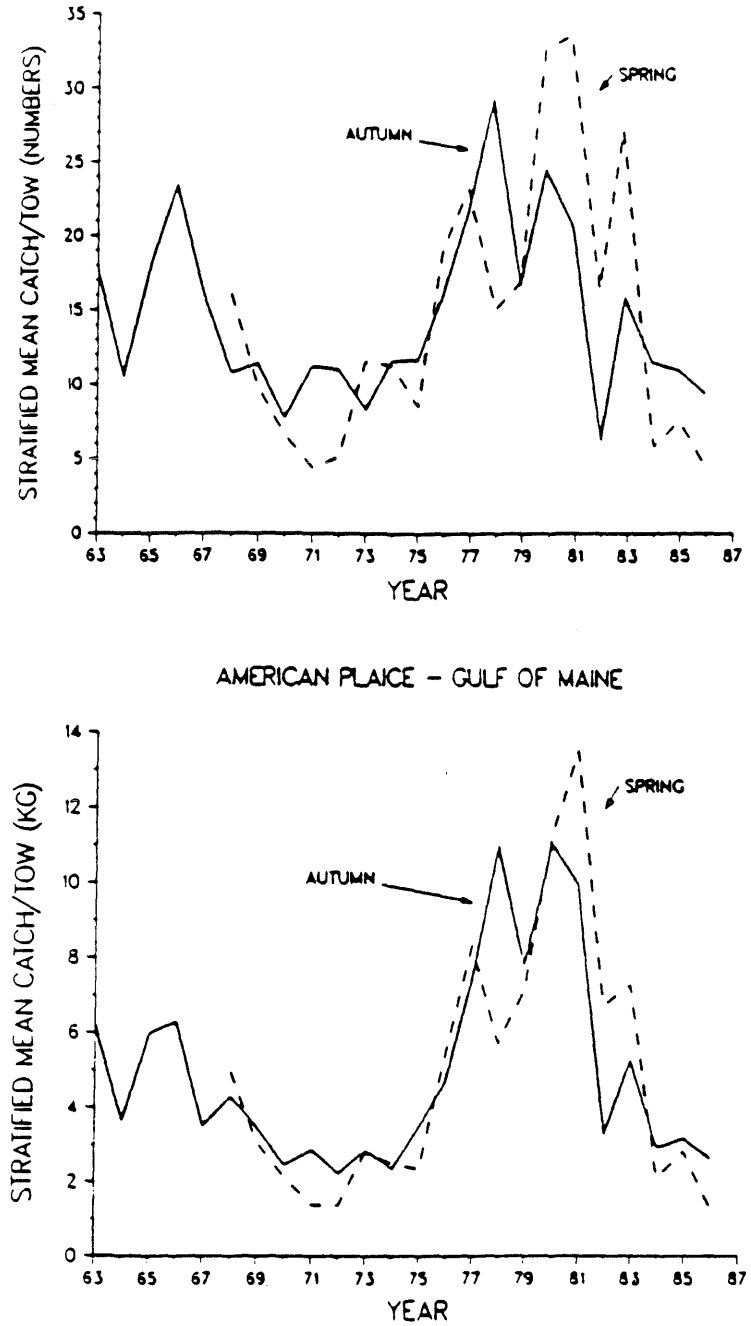


Figure III.3.4. Stratified mean catch per tow in numbers and weight (kg) for American plaice from USA offshore spring and autumn bottom trawl surveys in the Gulf of Maine (Strata 26-30 and 35-40).

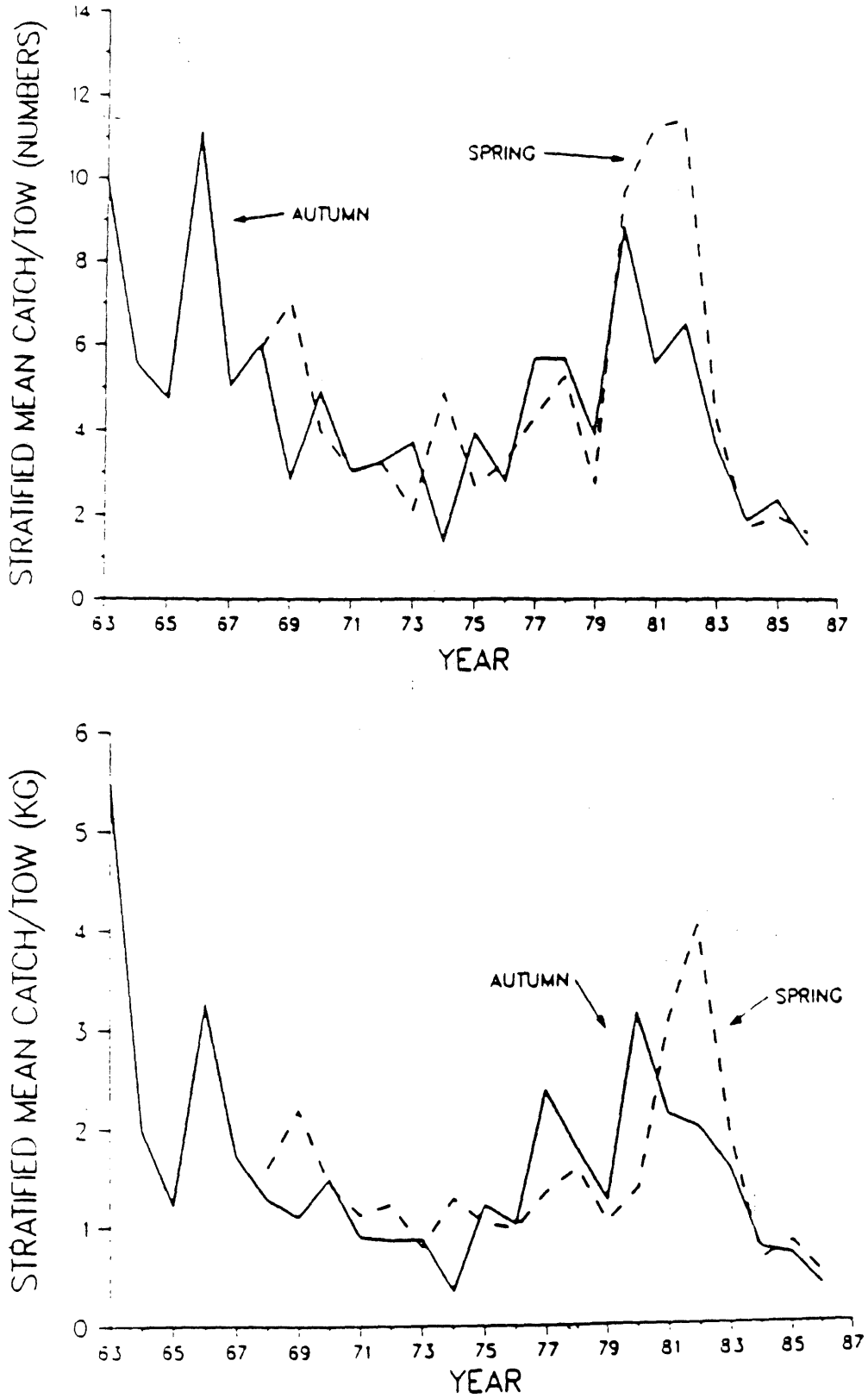


Figure III.3.5. Stratified mean catch per tow in numbers and weight (kg) for American plaice from USA offshore spring and autumn bottom trawl surveys on Georges Bank (Strata 13-25).

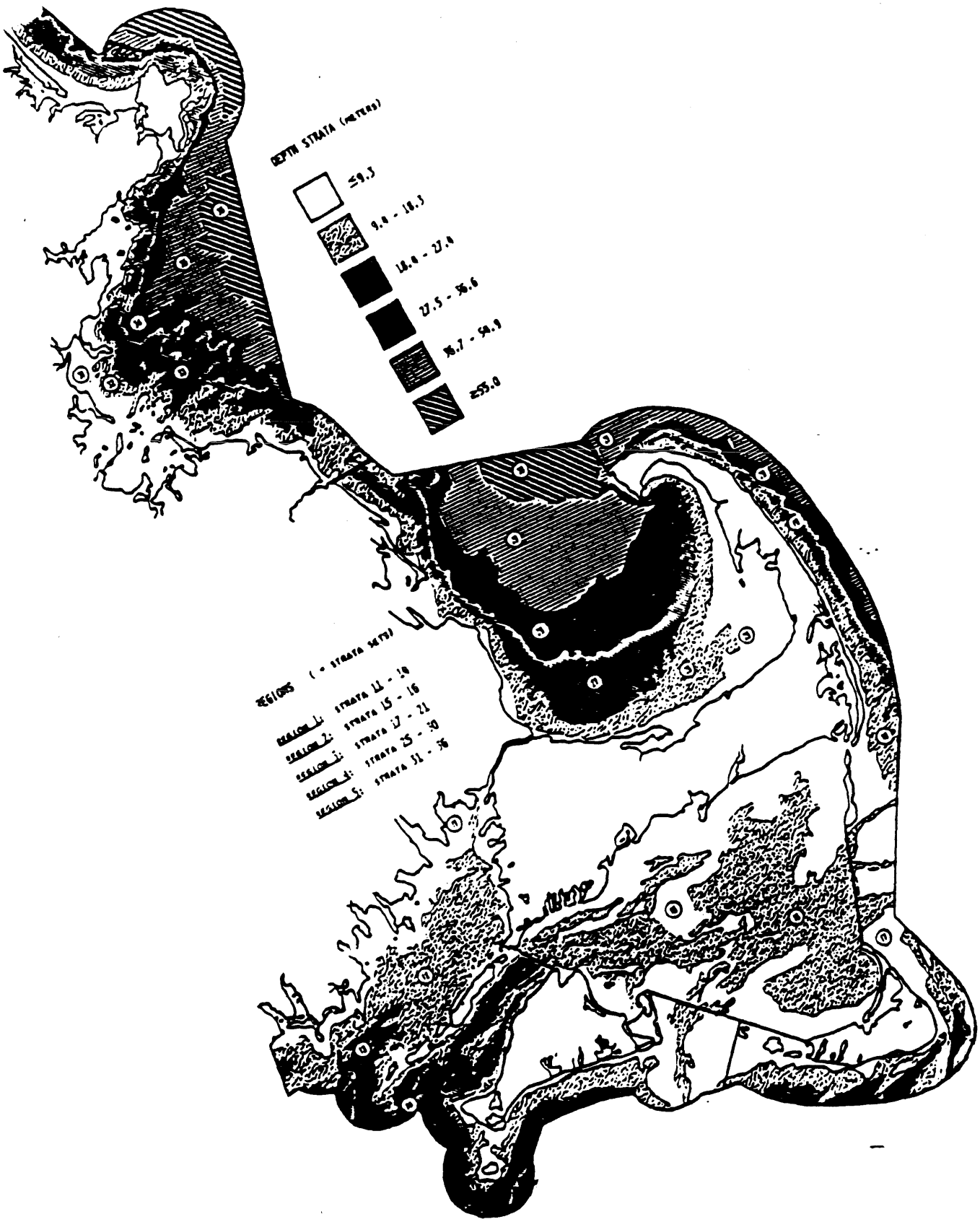


Figure III.3.6. Sampling strata used in Massachusetts DMF inshore bottom trawl survey.

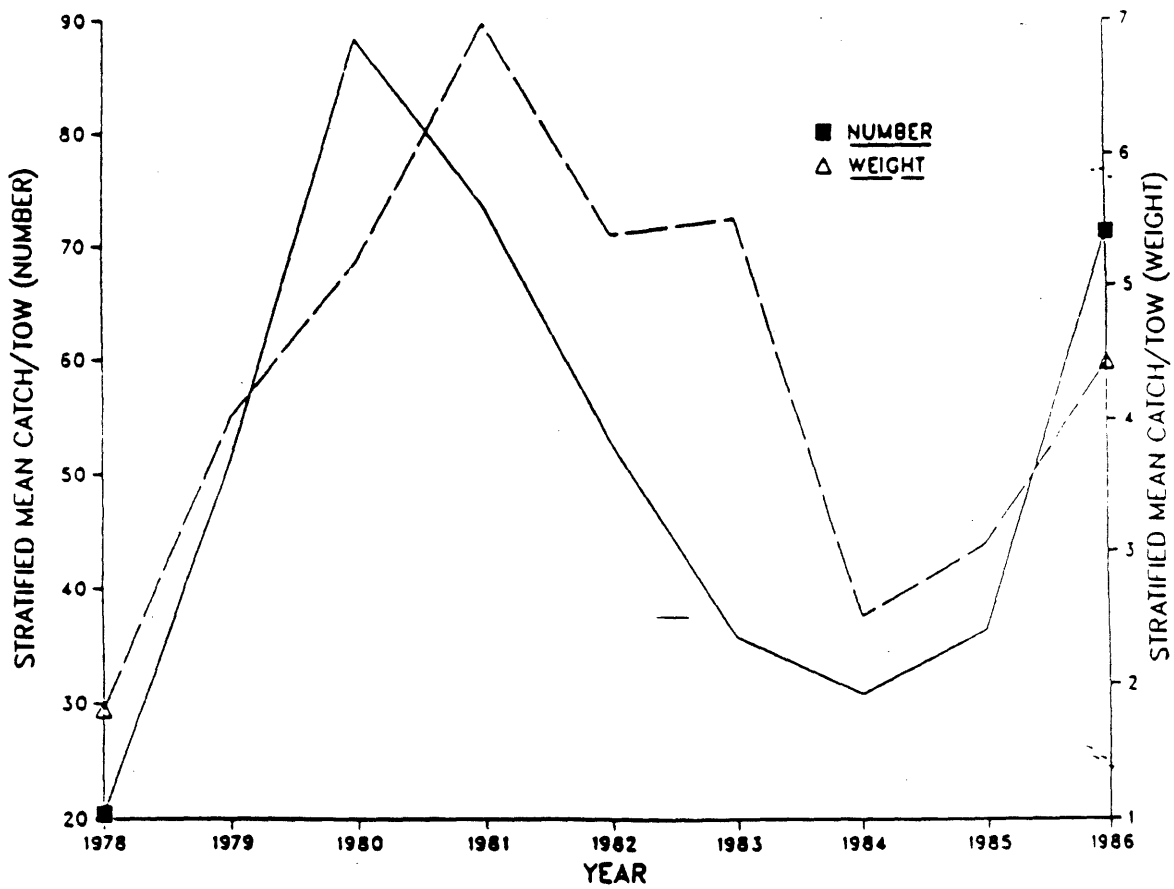


Figure III.3.7. Abundance indices (stratified mean number and weight per tow) from the Massachusetts Division of Marine Fisheries spring bottom trawl surveys (1978-1986).

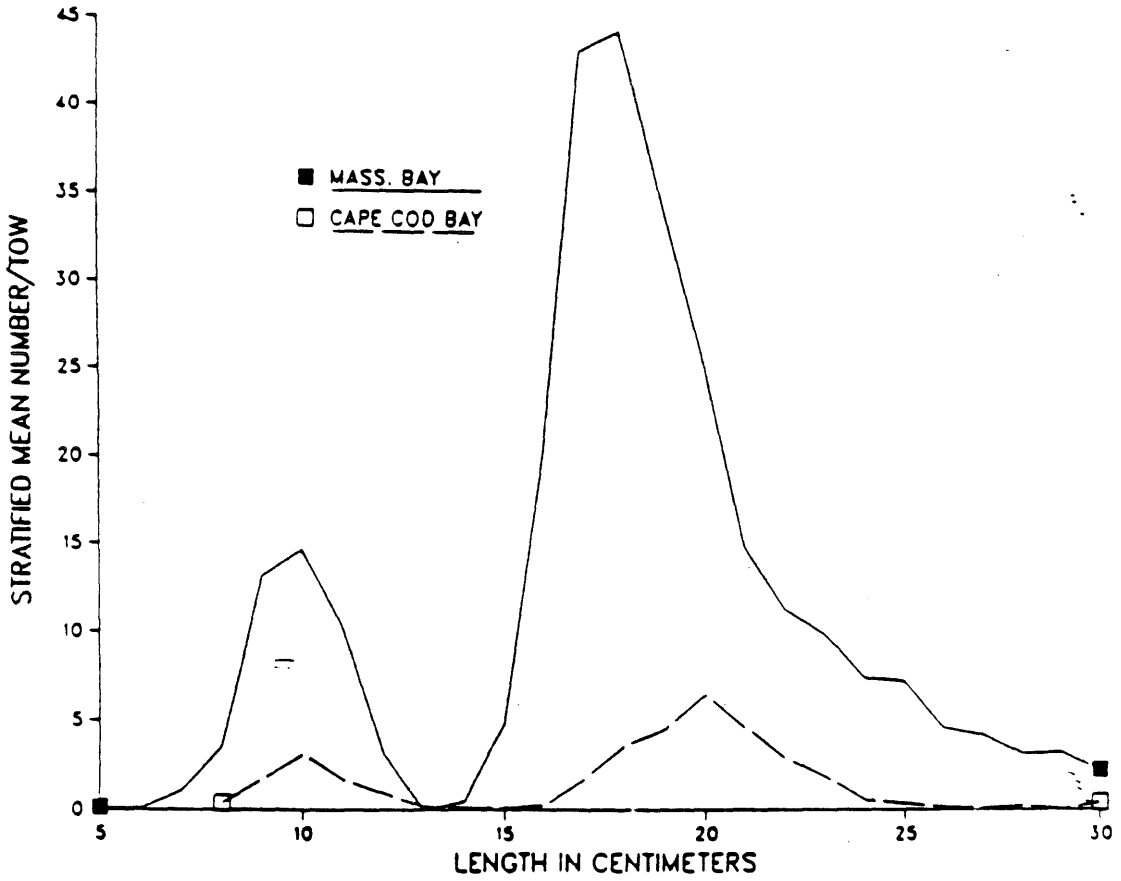


Figure III.3.8. Stratified mean number per tow at length for American plaice from the spring 1986 Massachusetts Division of Marine Fisheries bottom trawl survey from Massachusetts Bay and Cape Cod Bay.

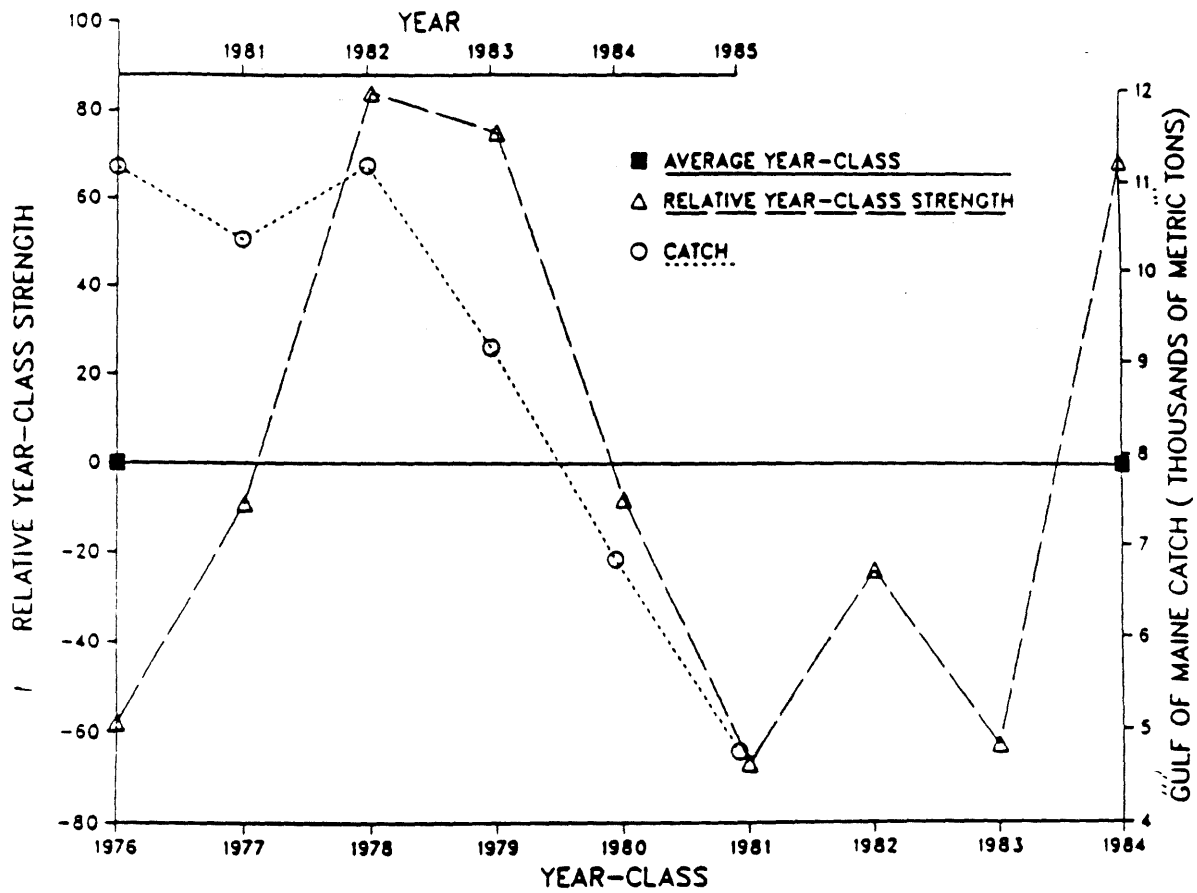


Figure III.3.9. Relative year-class strength and catch for Gulf of Maine American plaice.

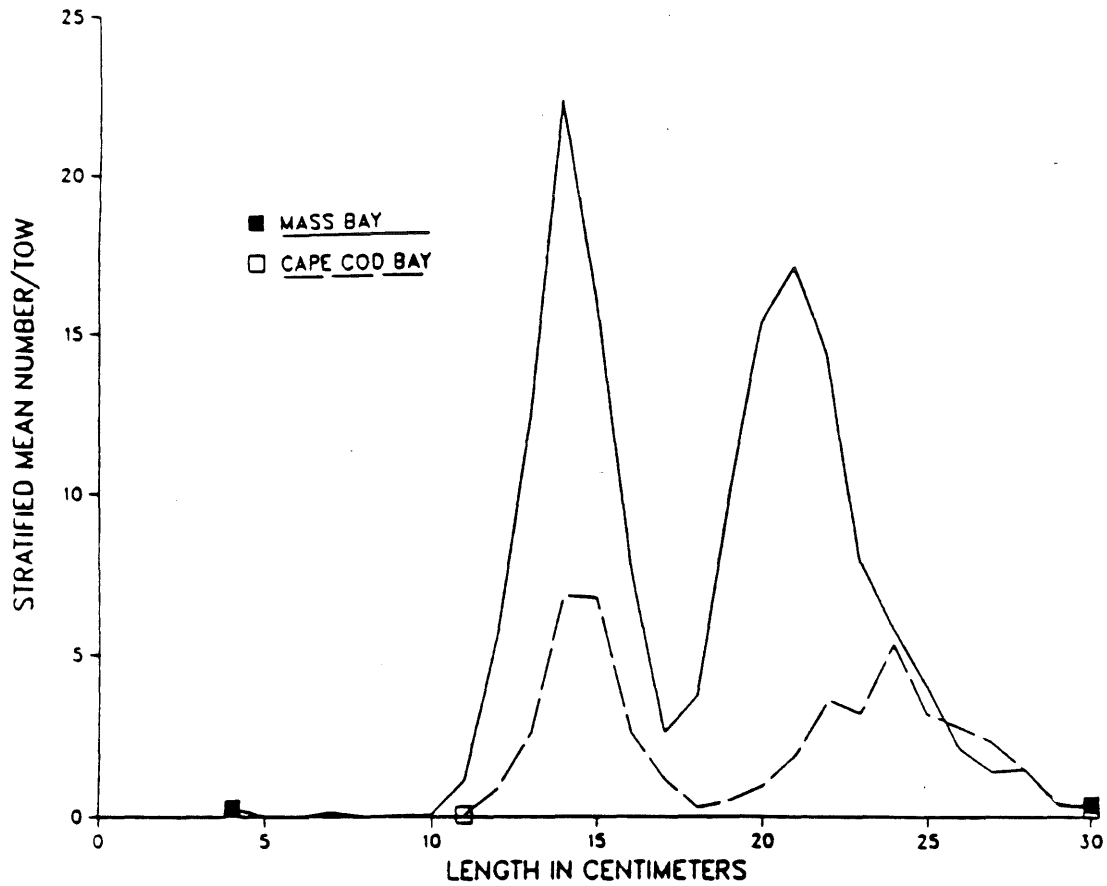


Figure III.3.10 Stratified mean number per tow at length for American plaice from the autumn 1986 Massachusetts Division of Marine Fisheries bottom trawl survey from Massachusetts Bay and Cape Cod Bay.

IV. WORKING GROUPS

1. WG 5 EXPERIMENTAL MACKEREL FISHERY

Terms of Reference

This group was established to develop a working paper on the scientific value of such experiments, as described in this report under the species review of mackerel as well as in discussions of priorities for subsequent workshops. Bill Overholtz and Steve Murawski will act as co-chairs, and other participants include Tim Smith and Brian Rothschild.

Report

Recent estimates suggest that the Northwest Atlantic Mackerel stock has increased dramatically since a collapse in the late 1970's after a period of intense foreign fishing. A succession of moderate to good year classes from 1981-1985 caused the stock to increase rapidly and biomass is now approaching levels observed in the early 1970's. Historically, mackerel has been an important species to the USA domestic industry; landings records from the 1800's to more recent times reflect the importance that this species once had in the east coast fishery. Declines in some of the more prominent species in the region have made mackerel an attractive alternative, at least in terms of volume. Assessment advice over the last several years has suggested that the stock is in very good condition and could provide catches in the 300,000 mt range. Allocations to joint ventures (JV) have increased substantially over the last several years and if all of the 1987 allocations are taken, a catch of roughly 75,000 mt would result from this source alone.

Pelagic species such as mackerel are often so abundant that they have a impact on their food resources. At high stock size, such as the present situation, one would expect the normal stock index variables such as growth, % maturity at age, fecundity and natural mortality rates to exhibit a density dependent response. The first three variables should decline as stock increases and one could at least hypothesize that natural mortality rate would increase with increasing density since many predators would be attracted to an available prey source with the correct size distribution.

A preliminary analysis suggests, however, that recent assessment advice has probably been too optimistic for this stock. An examination of data from the commercial catch, 1978-1985, and the NEFC spring groundfish survey data, 1976-1986, suggests that mackerel growth is influenced negatively by increases in stock size; this is consistent with the recent declines in mean weights that have been observed in the commercial landings.

Natural mortality rates may also be much higher than previously thought, and may be proportional to year class size, instead of constant over all age groups. Consumption estimates for silver hake, cod and spiny dogfish were calculated with feeding data from 1973-1985. The estimates were based on residence times of the predator and prey, percentage of mackerel in each predator diet, daily ration estimates of the predators by season where

available, availability of 1 and 2 year old mackerel in the sea, and biomass of predators of the correct size, approximately 3+ years old.

Prey lengths during 1981-1985 ranged from 12-35 cm, but were primarily 30 cm or less in these predators. An examination of annual data from 1981-1985 suggests that age 1 and 2 fish from the 1981, 1982, and 1983 year classes were eaten most frequently. The absence of mackerel in the diet of these predators in 1985 may be explained by the lack of age 1 and 2 fish in the sea.

Consumption estimates for these three predators were combined with landings at age for 1973-1980 and a new VPA completed for these years. The mortality rates from the VPA were a proxy for F and M2 and were apportioned by using ratios from the previous VPA. Natural mortality rates (M2's) ranged from 0.2-0.7 for age 1 and 0.1-0.4 for age 2. For illustrative purposes a residual natural mortality rate (M1) of 0.2 was combined with the calculated rates to obtain annual estimates of Z. These new rates necessitate the recalculation of YR for the stock giving a value for $F_{0.1}$ of 0.275, slightly lower than the previous number.

A simulation model that incorporates density dependent changes in growth, percent maturity at age, and natural mortality at age was constructed. The model was used to project $F_{0.1}$ catch for 1987 to use as a comparison with previous assessment advice. A new Partial Recruitment vector was also used in the analysis. Several studies by researchers in Canada suggest that a PR vector that is more moderately dome shaped than the one presently being used is more appropriate.

Results indicate that the projected catch for 1987 would be about 25% lower under the density dependent hypothesis. The results also indicate that if recruitment over the next several years is moderately high (2042 million fish) a more appropriate level of catch at $F_{0.1}$ would be in the 180,000 mt range. These results are similar to those found in the most recent Canadian assessment, suggesting a catch of about 200,000 mt for 1987.

Discussion

The objectives of the working group were to consider (1) the effects of development of an experimental fishery for mackerel and (2) the implications of density dependence in growth, maturity, and natural mortality on mackerel population dynamics. Mackerel is currently a dominant component of the fishery system in the Northwest Atlantic; abundance levels are now comparable to those of the early 1970's when mackerel stocks were high. The two objectives of the working group are related since it would be of interest to perturb mackerel population levels deliberately through an experimental fishery and determine whether vital statistics such as growth, maturity, and natural mortality change accordingly. The working group focused primarily on the second objective in their report.

Results of simulation studies were described in which empirically derived estimates of linearly density dependent growth and maturation were considered. In addition, age-specific natural mortality rates were partitioned into two components, predation and "residual" mortality (disease, etc.). Consumption

estimates were based on NEFC food habits data for three predators: cod, spiny dogfish and silver hake. The bulk of the mackerel preyed upon by these predators were 15-25 cm FL (ages 1-2); 0-group mackerel were found in predator stomachs only in one year.

Simulation results which incorporate density dependent mechanisms result in less optimistic forecasts of future yield than standard analyses. The lower projected biomass levels appear to reflect the lower mean-weight-at-age at high stock biomass used in the new simulation. The results are more in line with assessment advice provided by Canadian scientists for this stock.

Although the new simulations result in lower projected biomass levels, it was noted that, in fact, the density dependent mechanisms should provide more "buffering" for the stock and the stock should be capable of withstanding higher levels of fishing mortality. The $F_{0.1}$ management strategy currently in place does not account for such density dependent mechanisms.

It was noted that the structure of the simulations imply a predator switching mechanism (i.e. predators may switch between prey type according to the availability of the prey). It would be useful to validate this assumption. Also, there have been changes in the sampling protocol for food habits data which must be considered in any empirically based analysis of this type.

2. WG 7 CHANGES IN CATCHABILITY

Terms of Reference

The possibility of detecting changes in catchability by comparing survey indices and virtual population analysis (VPA), and 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 some data.

Report

Based on discussions at the 2nd and 3rd SAWs, WG 7 was formed to determine how the catchability coefficient changes with stock abundance. The idea of an increase in catchability as stock size declines was explored and analyses presented. A brief description of the mathematical concept was summarized and a case history given using Georges Bank haddock as an example. The catchability (q), the proportion of the stock removed by each unit of fishing effort, is generally expressed as:

$$q = F/f,$$

where: F is the instantaneous fishing mortality rate and f is fishing effort. Historically, the catchability coefficient (q) was assumed to be constant or, at least unrelated to stock size. Recent evidence, especially on schooling pelagic fishes, has shown that q may increase as stock size declines due to the non-random search behavior of fishermen and to changes in the spatial distribution of the stock. Estimates of the catchability coefficients (q) from 1964 - 1984 were fitted against fisheries-independent estimates of stock abundance (N) by the power function:

$$q = aN^b$$

where a and b are constants estimated by nonlinear least square regression. If the catchability coefficient is inversely related to N, then b will be negative and statistically different from 0.

A brief history of the haddock commercial fishery on Georges Bank was presented. The NMFS fall survey on Georges Bank from 1964-1984 was used as a fisheries-independent estimate of stock size (N). Data from the fall survey were compared with the October USA commercial catch and effort data from trips catching more than 25% haddock for all six strata combined on Georges Bank. A relative index of abundance of haddock stock size was expressed as the overall mean of all strata.

There was a strong positive correlation ($r = 0.91$, $p<0.001$) between the survey index and the VPA index for Georges Bank haddock, 1964-1984, so these two indices can be used interchangeably. The total catch of haddock in October was calculated as the sum of all landings wherein haddock comprised at least 25% of the total catch. The October catches was also correlated ($r = 0.75$, $p<0.01$) to the total annual harvest of haddock whereas the total number of trips made within each stratum was highest in area 521, the average number of days fished per trip were always highest on the Northeast Peak.

The consequences and methods of determining catchabilities of the haddock fishery were then presented. A numerical type response was demonstrated whereby the amount of commercial fishing effort on Georges Bank in October was positively correlated with the VPA estimate of stock size the previous year. It was questioned if this was due to the definition of directed fishing trip used. It was also noted that a similar type response was occurring between effort and the population estimate in the same year. Thus it was shown that the amount of fishing effort on haddock is directly linked to stock size. The catchability coefficient from 1964-1984 rose as population size declined, resulting in a decoupling between fishing effort and fishing mortality. The question of whether catchability increased as the area occupied by the stock declines was then addressed. A method was presented to estimate gross changes in the relative area under which the haddock stock was found. The analysis suggests that as population size declined during the mid-1970's an increasing percentage of the population became concentrated to the Northeast Peak of Georges Bank. This was supported by the inverse relationship between relative abundance and relative area, as well as between catchability and relative area occupied.

Whereas an inverse relationship between catchability and population size is well known for schooling pelagic fishes, this same phenomena has recently been noted for anadromous and demersal fishes and is probably occurring in many populations where the spatial distribution of the stock changes with abundance. This is potentially a serious problem since if constant catchability is assumed for a fishery, CPUE will not decline proportionally with stock abundance. Instead, CPUE will decrease, slowly at first, and then precipitously as the population size approaches zero.

3. WG 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.

Report

This working group on long term potential yield presented a set of three preliminary reports from its three members on progress to date.

Brian Rothschild presented an overview of the 3 branches of fisheries theories that can be used to address the question of long term potential yield:

1) production models,
2) yield per recruit analyses,
3) stock-recruitment theory.

He briefly described some of the strengths and criticisms with these different approaches and stated that the production model approach is an integration of the other two theories. He is in the process of preparing a written summary of the ideas he presented which will be included as an appendix to the report of this working group to be presented to the next SAW. He expressed concern that all three approaches are based on an assumption of stationary conditions. When a stock collapses or fails, one doesn't always know why based on the theory, and examination of models can not tell you why. He also stated in this connection that stock assessment cannot be considered an exact science but is an art requiring lots of interpretation. Gaps exist between the equations and the real world because the assumptions are not met and the data are noisy. He also stated that it is important to take each model as far as possible, recognizing that there will be problems. The overcoming of these problems is where the art of interpretation becomes important.

Mike Fogarty presented a report on the importance of collecting fecundity estimates over a range of stock sizes. Traditional theory assumes that a constant relationship exists between spawning stock biomass and fecundity. In fact the actual relationship is likely to be a concave downward function due to shift in ages of maturity, changes in growth rates and change in age structure that occur with changes in stock sizes. Such a non-linear relationship can provide one mechanism of compensation in the stock recruitment relationship and has implications about biases in estimating stock and recruitment relationship from estimates of spawning stock biomass. He stated that there is a need to couple these fecundity effects with the processes involved survival of eggs and larvae to produce a model for the

overall stock and recruitment relationship. Preliminary models were presented which combined separate functions for egg production as a function of spawning biomass and functions for survival rates of eggs and larvae as function of density. The resulting models yielded equations with 3 parameters which allow more flexibility in the shape of the stock recruitment relationship than do traditional models. There is a need to go back to first principles to attempt to deduce the dynamics of a population from a knowledge of the biology of the species. It is important to collect time series of data on egg production.

Points of discussion following this presentation included:

1) Traditional methods of measuring of fecundity actually measure potential egg production rather than realized fertility because a significant proportion of the eggs may never be released.
2) In order to evaluate the importance of the effects described, it is necessary to know the magnitude in the changes in the various rates that are likely to be observed. It was asserted that the magnitude of the effects are large and would have significant effects on the stock-recruit relationship.
3) The question of whether such effects would be greater in short or long-lived species was raised.
4) Future research in this area can be can be separated into 2 components: (a) the development of models which can be used to determine what the possible effects are, and (b) the collection of data to test these models. The first of these activities can be initiated immediately.

Vaughn Anthony presented the third report of the Working Group. He stated that if the data are examined in a non-parametric way, tremendous changes in a species' vital rates can be detected. There is good evidence for compensation in growth, fecundity and maturity. The question is how to incorporate this evidence when assessing long-term potential yields. The problem with a production model approach to the question of long-term potential yields is that it assumes that the observed data points cover all future conditions. In the past, stock sizes have usually been much higher. It is not clear that these past conditions are relevant for predicting future long-term potential yields. He stated that the question of long-term potential yield arises from the need to calculate MSY for fishery management plans. Where data are insufficient, other approaches are acceptable. He suggested that the question should be addressed based on the situation that a fisheries finds itself in today. The calculation of long-term potential yield should be based on a limited time horizon relevant to the management plan.

He suggested that yield per recruit analysis offers a practical solution and allows the estimation of future catches to be based on real time data from the present stock. However, to use yield per recruit for predicting long-term potential yield for the next 5 or 10 years still requires estimates of recruitment. He suggested the use of an average recruitment estimate based on the historical data. He emphasized that problems exist in using the complete range of historical data and suggested that only that portion of the data which represents present and likely near future conditions be used. He illustrated this point with an example of observed stock and recruitment data

from haddock. The average estimate of recruitment is much higher if all the data are used compared to using only the recruitment estimates from stock sizes near the present stock size. He also stated that long-term potential yield will likely be neither sustainable or maximal.

The Chairman of the Working Group presented a short statement on future research needs in this area based on some preliminary discussions within the working group. Some of the topics considered were:

1) Initiation and continuation of data collection needed for yield per recruit analyses.
2) Development of stock recruitment models which incorporate a more sophisticated description of fecundity.
3) Collection of data to test and parameterize these models.
4) Development of a new production model which incorporates theories of egg and larval survival rates.
5) Examination of problems with yield per recruit, spawning stock biomass per recruit, spawner recruit, and surplus production.

Extensive discussion occurred following the presentations. Points of discussion included:

1) In looking at stock recruitment data, the problem of error in measurement needs to be resolved.
2) In estimating stock-recruitment relationship, is it valid to exclude extremely large year classes such as the 1963 year class for haddock? It was asserted that this was valid because the probability of getting such large values was so small that its consideration was not useful for management purposes. Also, it was suggested that in trying to develop stock recruitment relationships drawing lines by hand may be preferable to an analytically fitted curve.
3) The question was raised whether it was reasonable to assume that the same density dependent processes and rates operate for a population when it is declining compared to when it is increasing.
4) The point was discussed whether there is a big boom phenomena in which an extremely large year class occurs just prior to a stock collapse.
5) The question was raised whether the report by Anthony implies that the best predictor of the future state of the system is its current state. It was cautioned that such an approach does not allow for the possibility of stock collapses.
6) The problem of determining long-term potential yield depends on the time frame that is to be considered. If a short time frame is used relative to the life history of a species, the effects of any compensatory mechanism will not be as important.
7) The use of spawning stock biomass for assessing long-term potential yield is predicated on the assumption that more eggs implies more recruits. How can such an assumption be tested? It was stated that a simple change in the number of eggs does not translate directly into a comparable change in recruitment. It is critical to understand what generates unusual recruitment and the opinion was expressed that we are on the edge of gaining this understanding.
8) If estimation of long-term potential yields are to be based on parameter estimates (such as recruitment rates) which only use data

from the recent past, there is a need to develop objective criteria for determining the time frame for selecting the data to be included.

9) It was suggested that if a new production model is developed then the trade off of adding additional parameters compared to the traditional models needs to be considered.

Following this general discussion, a short discussion followed on the future actions to be taken by this working group. The need to include a broader participation within the working group was perceived, particularly the need for input from the Management Council. It was agreed that the working group would continue to function with the addition of members from the Council Staffs and that the working group would prepare a written report for review by the next SAW.

4. WG 10 DIFFERENCES IN CATCHES OF SUMMER FLOUNDER REPORTED IN OFFICIAL USA STATISTICS AND USED IN ASSESSMENT ANALYSES

Terms of Reference

Identify differences between USA 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, Joan Palmer, and Mike Fogarty.

Report

During the Third SAW, it was suggested that the discrepancies between the official USA landings statistics and the landings data in the NEFC data base should be accounted for by North Carolina landings from south of Cape Hatteras. To test this, we obtained North Carolina summer flounder landings by county for 1979-1985, and subtracted the landings from south of Cape Hatteras from the official statistics. The remainder represents the actual discrepancy between the official and NEFC data.

Year	Official minus NEFC (MT)	NC South of Hatteras (MT)	Discrepancy (MT)	Discrepancy as % of total official ldgs.
1979	3595	2130	1465	8.1
1980	4058	1942	2116	13.6
1981	2742	1651	1091	10.2
1982	1654	1544	110	0.9
1983	2795	1495	1300	8.9
1984	3832	2310	1522	8.4
1985*	3793	2277	1516	9.7

*preliminary data

The differences ranged from 0.9 to 13.6% of the total official landings per year, and averaged 8.7% over the 7 years examined.

The discrepancies occur for a variety of reasons, the most general of which is that weigh-out data collected by NMFS port agents is reported to NEFC while data collected by the states is reported to Washington. This creates a number of problems, including:

(1) landings reports which are received late by Washington are sometimes not reported to NEFC, and

(2) adjustments made in Washington to estimated landings may not be reflected in the NEFC data base.

In addition, errors in the weigh-out data base which are detected after the data have been summarized in Washington cannot be traced to the more detailed records in the NEFC data base for correction.

The landings figures in the NEFC data base are consistently lower than the Washington figures. This is because data which are received after NEFC provides landings statistics to NAFO are not added to the NEFC data base. This problem should be corrected by updating the NEFC data base whenever additional data are received.

Discrepancies may occur for all NEFC species, but are probably more frequent for southern species due to a greater dependence upon data collected by state agents in the southern states.

To circumvent such problems, the Working Group recommends that the official data base be used for applications where summarized data are sufficient. The Fisheries Statistics Branch of the NEFC has requested official data from Washington and will make them available for use in assessments for all species. Comparisons should be made between the Washington and NEFC data for species of interest to determine whether significant discrepancies exist; the most appropriate data base should be used.

Several of the problems which have created discrepancies between the Washington and NEFC data bases in the past are presently being resolved. For instance, errors which were previously detected after the data was summarized in Washington are now being detected when the data are in detailed form and can thus be corrected in the NEFC data base. This is possible because port agents were supplied with microcomputers in 1985 and are now entering and auditing data in the field. However, until all data are reported to a single location, discrepancies will continue to occur. Ultimately, all data will be reported directly to NEFC, and from NEFC to Washington, thus assuring consistency of data bases.

5. WG 11 LONG-FINNED SQUID AVAILABILITY

Terms of Reference

This group was formed to develop research terms of reference to address issues of availability of long-finned squid to the squid fishery relative to NEFC survey abundance indices and estimates. Participants were: Anne Lange (Chair), Mike Fogarty, Arnie Howe, Dick Allen, Sal Testeverde, and Dave Keifer.

Report

The members of the working group recommend that NEFC spring and autumn survey data and possibly MA survey data be analyzed to determine if an index of fishable concentrations (or densities) can be developed which can then be related to subsequent domestic catches. The proposed approach to development of such an index is to calculate the relative proportion of tows for each survey (year and season) which contained high concentrations of squid. If a relationship between such indices and the subsequent domestic catch can be identified, additional analyses should be conducted to determine if this may be a useful index of availability which managers may use to predict what portions of the overall stock may be available to the domestic fishery.

Discussion

The research terms of reference developed by the Working Group are especially related to the information needs of the Mid-Atlantic FMC. Priorities for completing this research were not addressed.

6. WG 12 SCIENTIFIC GOALS OF COLLECTING DATA ON FISHING VESSELS

Terms of Reference

Evaluate the utility of a sea sampling program for collecting scientific data for enhancing our ability to assess the status of stocks and the likely or actual impact of specific management measures. Evaluate the likely magnitude of such a program to meet different objectives. Consider at least the objectives of measuring discarding practices, evaluating mesh selectivity, and refining measures of fishing effort. This WG should list fisheries in priority order that need sea sampling. Participants were: John Mason (Chair), Dave Pierce (Mass), Howard Russell (NEFMC), Jeff Ross (NC), Fred Serchuk (NEFC), Frank Almeida (NEFC), Ronnee Schultz (NEFC).

7. WG I3: ADEQUACY OF PRESENT PORT AGENT INTERVIEW SYSTEM

Terms of Reference

Evaluate the present system of port agent interviews in terms of coverage and the questions asked to determine if it might be able to provide better and more detailed information on catches, fishing effort and fishing practices. Alternate sources of data or methods of collecting such information should be identified. Potential participants identified were: one member each from the MAFMC and the NEFMC staff, Darryl Christensen (NEFC), Sukwoo Chang (NEFC), Dave Stevenson (ME).

V. SPECIAL TOPICS

1. RECREATIONAL DATA

The recreational catches of Northeast Atlantic Coast species such as Atlantic mackerel, striped bass, bluefish, summer flounder, and winter flounder equal or approach their respective USA commercial landings. The recreational catch of Atlantic cod, scup, and black sea bass is greater than 10% of total landings (Table V.1.1). For these stocks, the Marine Recreational Fishery Statistics Survey (MRFSS) is an important source of data for determining status of the stocks. In work performed at the NEFC over the past 6 months, the following problems concerning the use of the MRFSS data have been addressed as part of the assessment of bluefish:

Use of catch type B2

MRFSS catch is reported as 1) type A, catch available for identification and measurement of length and weight, 2) type B, catch not available for identification, and either used for bait, cleaned, or discarded dead, and 3) type B2, catch released alive. The work in the literature dealing with release mortality in recreational fisheries mainly concerns salmonids and freshwater species; little has been done to estimate the hooking mortality of saltwater game fish. In salmonids, hooking mortality of released fish caught on bait varied from 5 to 50%; mortality of lure caught fish varied from 1 to 40% (Wydoski 1977). Given the lack of data, the ASMFC Bluefish Assessment Subcommittee chose to assume 100% hooking mortality, and include type B2 catch in the estimation of total recreational catch. For bluefish, type B2 catch averaged 15% of total catch numbers during the 1979-1985 period.

Calculation of total catch weight

MFRSS publications report the weight of fish caught for only catch type A, since no data are available on the length/weight characteristics of type B catch. In assessment work, however, there is a need to estimate the weight of all fish caught (e.g., in order to monitor trends in catch per unit effort). The NMFS National Fishery Statistics Program in Washington, D.C. has advised the NEFC on an appropriate procedure for this calculation using the expanded estimates data (pers. comm., R.J. Essig). Expanded data may first be sorted by coastal subregion (North Atlantic, Middle Atlantic, South Atlantic), angling mode (man-made, beach/bank, private/charter boat, private/rental boat), and area (inland, territorial sea, EEZ). The calculation of total catch weight is then made by assigning weight per fish of type A catch to total numbers in the subregion/mode/area cell:

$$(\text{wgt A} / \text{num A}) * (\text{num A} + \text{B1} + \text{B2}) = \text{wgt} (\text{A} + \text{B1} + \text{B2}).$$

Total weight in the cell may then be summed at whatever higher level cell size (e.g., subregion/mode) is appropriate for the fishery of interest.

Length frequency of total expanded catch

Assignment of lengths to catch types A and B is made by merging intercept length frequency data with expanded estimates. Initial attempts at this merging procedure here at NEFC sorted catch at a wave /subregion /state /mode /area cell level, and yielded catch totals different from published totals. Adjusting the cell size to the same level used in the assignment of weight provided totals consistent with those published.

Defining effort for individual species

The MRFSS does not provide an expanded estimate of directed species effort. Instead, several levels of summation in numbers of fishing trips are provided which may be used as indices of directed effort. Four options for this calculation have been considered. Option 1 is to use as an index of directed effort all fishing trips in subregion/mode/area where fishing for the species of interest occurs. Option 2 is to use all fishing trips only in subregion/mode/area cells where the species of interest is caught. Options 3 and 4 are to modify the above measures by the percentage of fisherman interviewed who indicated that they were seeking a particular species. Employing this latter "target percentage" may introduce bias due to a perceived tendency for fisherman to report that they are fishing for the species they actually catch. The Bluefish Assessment Subcommittee considered options 1 & 2, and found a high correlation between these measures of effort on a subregional basis. This relationship may not be as strong for species that are less frequently encountered, however, and the choice of options should probably be considered separately for each species.

Precision of the expanded catch estimates

Variances of the estimates of the three catch types and total catch in numbers by subregion/mode/area cell are provided in the expanded estimates data base. Additionally, estimated standard errors of the expanded estimates are provided in MRFSS publications for use in the calculation of confidence intervals of catch estimates at the subregional level:

$$95\%\ CI = \text{estimate} \pm 1.96 * (\text{estimate of standard error}).$$

Coefficients of variation, which express the standard error as a percentage of the estimate, are also provided as a measure of precision, and are useful for comparing the relative precision of estimates for different species. For Northeast Atlantic species with major recreational fisheries, the estimates for bluefish and summer flounder total catch numbers are the most precise (Table V.1.2), and are among the most precise of all the species included in the MRFSS.

Discussion

One of the purposes of this work was to develop standard methodology for utilizing the MRFSS. It was noted in the report that totals of estimates for cells subdivided past the subregion, angler mode and area level at times did

not approximate the published totals. It was recommended that estimates not be made from more finely subdivided data and it was noted that for less frequently caught species, estimates might have to be made from more aggregated cells. One of the problems with using further subdivided data to estimate catch weights was that at the most detailed level possible (wave/subregion/state/mode/area) 5-10% of the bluefish catches could not be assigned weights from information in that cell. Virtually all estimates for bluefish in a subregion/mode/area had associated weights. Concern was raised about determining the size composition for the catch from such aggregated data, and ignoring possible temporal effects or geographical effects within a subregion.

Additional concerns were expressed about estimating the size composition and weight of the released catch (B2) as well as the retained catch which could not be measured (B1).

It was suggested that the question of whether additional analyses of general methods for using the MRFSS data be conducted by working groups or whether such investigations should be done for individual species as the need arises.

Table V.1.1. Recreational catch as a percent of total U.S. catch (commercial & recreational) for Northwest Atlantic stocks with important recreational fisheries (>10% total catch in weight).

SPECIES	1979	1980	1981	1982	1983	1984	1985	1986
BLUEFISH	92	91	89	87	90	88	88	91
SUMMER FLOUNDER	33	60	26	27	50	42	37	42
SCUP	22	33	17	26	33	19	30	52
STRIPED BASS	55	20	18	60	56	14	57	82
ATLANTIC MACKEREL	65	47	64	25	44	41	19	29
BLACK SEA BASS	55	20	18	60	56	14	56	78
WINTER FLOUNDER	46	30	33	36	34	40	47	31
ATLANTIC COD	8	11	16	13	14	11	19	NA

Source: Status of the Fishery Resources for 1987 (In prep.). NOAA TM NMFS-F/NEC.

Table V.1.2. Precision of MRFSS expanded catch estimates. North and Middle Atlantic subregions: coefficient of variation of total numbers (A + B1 + B2).

NORTH (ME to CT)	1979	1980	1981	1982	1983	1984	1985	1986
BLUEFISH	10	14	30	14	20	11	23	16
SUMMER FLOUNDER	19	24	22	16	20	17	38	18
SCUP	17	12	20	21	15	21	16	13
STRIPED BASS	30	21	26	46	35	33	37	41
ATLANTIC MACKEREL	19	21	27	31	18	30	62	25
BLACK SEA BASS	46	46	30	39	26	30	33	19
WINTER FLOUNDER	11	6	19	39	12	12	17	27
ATLANTIC COD	17	17	23	23	15	19	26	27
MIDDLE (NY to VA)								
BLUEFISH	5	6	19	14	8	12	10	7
SUMMER FLOUNDER	28	4	11	43	12	12	16	8
SCUP	17	13	28	16	24	34	23	16
STRIPED BASS	19	10	18	32	33	19	21	25
ATLANTIC MACKEREL	51	61	57	43	45	57	58	32
BLACK SEA BASS	14	8	15	42	22	18	13	24
WINTER FLOUNDER	14	9	13	12	21	12	25	10
ATLANTIC COD	--	9	13	12	21	12	25	10

--: < 30 thousand fish reported

2. SHELLFISH DISCARD STUDY

An overview was presented of preliminary first-year results of an NEFC study to evaluate incidental (dredge-induced) and culling mortalities of commercially valuable offshore clam and scallop resources. The 1986 field research was conducted during 9-18 July using the manned research submersible JOHNSON SEA LINK I and its supporting vessel EDWIN LINK. Four other vessels participated in the study: F/V CAROLINA DAWN (a commercial sea scalloper), F/V JOHN MARVIN (a commercial surf clammer), F/V SHREWSBURY (a commercial ocean quahogger), and the R/V DELAWARE II.

The specific objectives of the research were:

1. To assess the efficiency of commercial and research vessel dredges relative to capture, retention and size selection of surf clams, ocean quahogs, and sea scallops.

2. To assess the magnitude of dredge-induced, non-capture mortality of surf clams, ocean quahogs, and sea scallops resulting from commercial fishing operations.

3. To evaluate short-term mortality of surf clams, ocean quahogs, and sea scallops returned to the sea during at-sea commercial culling and discarding activities.

The 1986 field work was conducted on commercial shellfish beds off the New Jersey and Delaware coasts at water depths from 70-220 feet (21-67 meters). A total of 16 submersible dives were accomplished; dive durations ranged between 2-3 hours. The general approach was to use the submersible to survey a dredge path made by one of the participating vessels and document, via videotape and still photographs, shellfish densities, dredge-related damage, and substrate disturbances. Discard and culling mortality was evaluated by placing marked individuals on the sea bottom and re-surveying the marking sites a week afterward to determine the fate of the marked shellfish.

The 16 dives yielded 40 reels of videotape and 5,600 still photographs. Although analysis of the still photographs has yet to be completed, the preliminary in-situ visual observations suggest that incidental dredge-induced mortality was relatively low for all three species; that bottom substrate disturbances due to dredging appeared minor; that culling mortality was low and seemed related to damage inflicted during the discarding process; that dredge tracks are often distinct for only a short period of time; and that predation on damaged shellfish on the ocean floor is intense and rapid.

The 1987 portion of the submersible study is planned for a five-day period in July. The emphasis of the 1987 research will be on sea scallops; cooperative work with the 1987 NEFC sea scallop research vessel survey is anticipated.

Discussion

Following the presentation, questions were raised concerning the impacts of commercial dredges on the benthic infaunal community; the impacts of various types of commercial dredges on shellfish beds; the potential for using remote operating vehicles (ROVs) to acquire underwater data; and the methods used to derive the shellfish discard mortality estimates. The questions were generated to clarify several points presented in the overview and not as issues for terms of reference for future SAWs.

3. REVIEW OF PROGRESS ON BLUEFISH ASSESSMENT

This report was presented in two parts: 1) review of catch statistics and estimation of natural (M) and total (Z) mortality, and 2) preliminary estimate of stock status.

1). A review of commercial and recreational catch statistics indicated that recreational catch in 1984 and 1985 was 40-45 thousand mt, down from the 60 thousand mt range of the late 1970's/early 1980's. Commercial catch averaged about six thousand mt during 1979-1985. Thus recreational catch accounts for roughly 90% of total bluefish catch and commercial catches roughly 10%. Total catch peaked at 76 thousand mt in 1980.

There are two distinct components of the recreational fishery: a shore-based fishery landing mainly young of the year (YOY) fish, and a boat-based fishery, landing mainly adult (age 1+) bluefish. The boat-based fishery catches a higher weight per unit effort, reflecting the catch of older, larger fish. Preliminary results indicate YOY fish are partially recruited and age 1 fish are probably fully recruited to the fishery.

Estimates of natural mortality (M) were derived from equations relating growth parameters and temperature (M = 0.35 to 0.43), and maximum age (M = 0.35 to 0.41). Total mortality (Z) was estimated by catch curve analysis of CT state trawl survey data, NMFS inshore trawl survey data, and recreational fishing survey data. Preliminary estimates of Z were quite variable, ranging from 0.2 to 1.15, with most values in the 0.4 to 0.7 range.

Two indices of abundance, 1) the NMFS inshore trawl survey, and 2) the recreational fishing survey estimate of the Mid-Atlantic shore-based CPUE of YOY bluefish, appear to be good recruitment indices. Initial analysis indicates that the 1977, 1981, and 1984 were strong year classes, while the 1985 and 1986 year classes were average.

2). The Shepherd method of combining results from traditional yield-per-recruit analysis with a stock/recruitment function will be used to determine levels of fishing mortality (F) that 1) provide maximum yield, and 2) are reflective recruitment overfishing. Both F levels are key reference points in managing the fishery.

A standard Ricker stock/recruitment model was initially applied to data from the NEFC trawl survey; results were poor (r^2 = 0.16), so environmental

variables were added which might account for some of the variability. Adding wind stress data off Virginia in March improved the degree of variability explained by the model (r^2 = 0.70), but an hypothesis for the functional relationship is lacking.

Current analyses indicate that fishing mortality (F = 0.30 to 0.35) is at a moderate level. However, if F increases with age or if catchability is inversely related to stock size, stock decline would occur much sooner than expected. One should be cautious about allowing expansion of the fishery since current F is not well estimated.

Several questions and comments arose during discussion following the report, including:

1) What is the relationship between wind stress and recruitment, and which is most important, magnitude or direction?

2) March wind stress vectors were found to correlate, but spawning off Virginia may be concentrated later in the spring. If so, what is the mechanism behind the wind stress/recruitment relationship? A functional study may be appropriate to resolve this question.

3) While adding wind stress did not substantially change the parameters of the stock/recruitment relationship, it did reduce the variability of the estimates of these parameters, and thus is an appropriate procedure.

4) The ASMFC bluefish S&S committee will try to develop a draft stock assessment and management plan by Fall 1987, but probably not for the 5th SAW.

4. REVIEW OF STRIPED BASS FISHERY INDEPENDENT MONITORING PROGRAM

Quantitative information on striped bass population structure has historically been very scarce because much of the striped bass catch is missed by the weigh-out system. Thus one of the priorities of the Emergency Striped Bass Study when it began in 1980 was to establish a program for monitoring the size and sex composition of the commercial catch of Atlantic striped bass. However, major regulatory changes have occurred since the early 1980s, and have undermined the usefulness of data collected from commercial landings. When the Inter-State FMP for striped bass was amended in June of 1985 to require a 33 inch TL minimum size by August 1987, it became clear that fishery-independent monitoring would be required to provide information needed for striped bass population assessments. Such a monitoring program has been developed by the ASMFC's Striped Bass Scientific and Statistical Committee.

The objective of the fishery-independent sampling program is to monitor the status of the Chesapeake and Hudson stocks of striped bass, both of which contribute significantly to the coastal fisheries. This will be accomplished by sampling the migratory stocks along the southeastern shore of Long Island during the fall. At this time, striped bass from both the Hudson and Chesapeake stocks are present and may be sampled close to shore. The sampling

will be done by haul seine on a randomly selected series of days between September and December. The catch will be weighed and measured, and subsampled for age and sex determinations. Scales will be collected for stock identification work, to allow stock-specific estimates of population parameters to be made. In conjunction with the sampling, striped bass will be tagged with internal anchor tags as part of the coastwide tagging program.

The data obtained from the monitoring program, when coupled with information on annual recruitment, will allow estimation of age, size and stock specific mortality rates and will provide a basis for assessing population responses management measures.

Discussion

Initial discussion centered on what parameters are to be estimated from the data. Parameters to be estimated include stock specific growth and mortality rates. A question was raised as to whether there is any reason to believe that scale shape can be used to discriminate striped bass stocks. It was noted there were encouraging indications of the utility of this approach based on preliminary research. It was noted that stock identification studies conducted by University of Rhode Island during the 1970's using Fourier analysis of scale patterns were not successful. The question was raised whether sampling of PCB's would be included as part of the project. Although not specifically part of this study, NY scientists will measure PCB levels in some sampled fish.

Questions concerning the selection of sampling sites and standardization of effort were addressed. There was some concern that weathering of beach areas would result in within and between year changes in bottom topography, thus affecting fish availability at the sampling sites over time. It was pointed out that the sampling sites are areas historically fished by NY seine fishermen, and that sites will not be adjusted within a sampling year. It was agreed that sampling sites should be monitored over time to evaluate sampling efficiency based on potential changes in beach topography.

Discussions also occurred on the long term controversy of stock identification, principally asking what is the evidence for different stocks between areas, what evidence exists for differences in vital parameters between stocks, and what will be done with the data? Differences in growth have been observed between stocks, but insufficient maturity data has been available to evaluate this difference. It was also noted that Maryland studies have shown significant differences in growth even within the Chesapeake Bay. Data collected in this study will be used to address the questions of stock affinity of migratory fish, and to provide information on the biological parameters of age, growth, maturity, and mortality. Furthermore, it was noted that since only a portion of the age groups from each stock will be sampled in the coastal monitoring program, these data will have to be evaluated along with those collected in the other monitoring programs.

5. MEASURING EFFORT IN MIXED SPECIES FISHERIES

Traditional analyses of effort in multispecies fisheries present problems in accurately characterizing CPUE (when combinations of single-species effort on "target" species are used), and in realistically defining a fishery (when assemblage analysis is used).

The aggregation of catch and effort statistics over large, ecologically significant areas, without assuming "directability" for single species components, can be used for an alternative type of analysis. Although this methodology may be robust, lack of correlation between aggregate fleet behavior and combined F's for single species may be a problem if in fact substantial directed fishing is occurring.

One large-scale study was presented that looked at data from three aggregate areas: Gulf of Maine, Georges Bank, and southern New England. Information on different tonnage classes, gear types and catch statistics for ten selected demersal species, as well as total landings, was assembled from 10 years of data. Effort was defined as "days fished", standardized to a class 3 Georges Bank otter trawler. Trends in effort, CPUE, and landed value were noted for three tonnage classes over the large areas. The character of fisheries in each area changed. Effort shifted among tonnage classes.

This analysis was considered a good "first cut" on a large data base. The relationship of fishing mortality to effort is the next area to be investigated: how can an effort measure, which refers to all species, be related to F's computed by species?

Questions were raised concerning small-scale changes in fisheries over time and space. This analysis did not address such complexities, but the analysis may be refined once suitable methods are developed. It was reiterated that for large-scale, aggregate analyses, such as the one presented, coarse-level effort and species assemblages need to be defined based on large ecologically-defined areas.

A point was made that horsepower may be a better variable for standardizing effort than tonnage class. This may be used in future analyses, although the data is not as available.

The New England Fishery Management Council staff has done analyses on vessel class performance over large areas and has overcome some of the difficulties in manipulating such large data bases by compressing the data.

A second approach was then introduced which attempted to characterize the spatial and temporal dynamics of the Georges Bank fishery with special reference to cod, using trend surface analysis. The approach can be used to examine effort distribution and its relationship to days fished, CPUE (landings per unit effort) and F. Temporal changes in effort, CPUE, stock structure and the mix of vessel tonnage classes can also be examined.

Changes in the number of "directed" trips for cod over time have occurred. Trend surface analysis may reveal spatial changes in effort related to "targeting" on cod. It was also hoped that effort changes due to quotas would be revealed by this technique.

The analysis involved characterizing spatial observations as a function of a trend plus an error component, which was assumed to be normally distributed with a mean of zero. Using polynomial regression in 2 variables a "surface" can be fitted to observations made on a grid. In this case, a grid was defined using 30' squares of latitude and longitude over Georges Bank. Analytic objectives were (1) to determine the degree of polynomial that represents the data, and (2) to find a prediction equation.

The number of fishing trips in each grid square were arranged by quarter of year, tonnage class, and percent range of cod in trip landings. Spatial concentrations of the fleet varied over seasons and according to the percent of cod in the landed catch.

Surfaces generated by such analyses can be compared by several methods. A cluster analysis of surfaces generated over years could be used, for example, to examine similarities between years for a given seasonal pattern of effort. Surface analyses could also be used to investigate trends in catch composition over seasons for a given area.

In examining the data prior to performing such an analysis the number of trips made by vessels from different ports was found to vary seasonably. Also, within months vessels from different ports tend to fish different areas of Georges Bank. It was noted that in cases where vessels from different ports fish in the same area in the same time period the composition of the landings of the vessels may vary according to their port of landing. Such differences were found between Provincetown and Gloucester boats. These differences have implications for the calculation of discard and indices of abundance which are based on interview data.

A suggestion was made that correspondence analysis may be an alternative to the cluster analysis used here. The similarity between this "surface" approach and analysis of variance was pointed out. The unlikeliness of boats discarding catch such as yellowtail (which were landed by Provincetown boats but not by Gloucester boats fishing in the same place and time) raises the question of why some boats did not land the same species as most.

6. MACKEREL SPAWNING STOCK BIOMASS ESTIMATION FROM EGG SURVEYS

Biomass estimation from ichthyioplankton offers an alternative assessment method. It is particularly useful where fishing pressure on the stock is low, as is presently the case with mackerel. When catch is low VPA methods become less useful.

We have a unique opportunity this year, due in part to our cooperative work with Poland for at least five reasons:

1) Fishery-independent methods like ichthyioplankton based estimates have been used before, but usually on a broad scale. This year we can concentrate intense sampling on mackerel.

2) We will have extensive stomach analyses for food habits data.

3) We can follow up on studies of genetic abnormalities in mackerel eggs that were done 10 years ago.

4) Due to cooperation with Canada, we can cover both the Mid-Atlantic bight and the Gulf of St. Lawrence.

5) We can look back to Sette's work of 40 years ago with similar types of data to compare to his results.

The area of sampling for the mackerel study off the USA coast will be chiefly from Cape Hatteras to the middle of Georges Bank. Two Polish commercial vessels began working in mid-January and will continue until 25 May. Standard age and length data will be collected. In addition we will follow the development of the gonads through time and select appropriate stages of ovaries for fecundity estimates. In the stomach contents analysis, we are looking for evidence of predation on fish larvae; predation on sand lance has been observed in the past.

The egg production estimates will be done in five stages beginning in the period 13-24 April for the area west of Long Island. The later stages progress northeastward along the shelf. The Polish research ship Wieczno will be doing the last three stages in late May and June.

Our Canadian counterparts will assist by collecting egg samples in the Gulf of St. Lawrence. A biologist from the Sandy Hook laboratory will be on board their vessel R/V Prince and the samples will be processed in the same manner as our own samples.

All of the samples will be sent to the sorting center in Poland where the eggs will be separated, staged and counted. An estimate of number of eggs spawned is made for each station and these estimates are expanded over the area of spawning using the delta distribution estimator. Using fecundity and stock structure data, a spawning stock biomass estimate is obtained. We hope to have an SSB estimate in about six months.

Looking at ichthyioplankton distributions since 1977 shows that we should be covering the temporal and areal extent of mackerel spawning.

We also will be obtaining additional data on genetic abnormalities in eggs, such as were observed by Arlene Longwell in the 1970's when higher frequencies of cytogenetic abnormalities were associated with polluted areas of the New York bight. We will be able to extend the area of observation beyond what she was able to sample, including the Gulf of St. Lawrence. In addition to preserved eggs we will also strip eggs and fertilize them at sea to document variability in the early embryonic stages.

Last year the Polish vessel observed mackerel moving east onto southern Georges Bank at the same time that our own gadoid survey indicated that 0 group gadoids were on the northern part of the bank, adjacent to but separate from the mackerel. Some mackerel stomachs from the boundary area between the two distributions did have larvae in them. Hope to follow up on those observations this year to explore the possibility that mackerel predation on 0-group gadoids may be a significant source of mortality.

Discussion

Q: Were herring, in the past, found north of the mackerel area shown on Georges Bank, as well?

A: The Polish captain did report some herring in the area in 1986.

Q: Fecundity would seem a weak point in the egg-based method, particularly for a serial spawner. How serious a problem does it represent?

A: It would seem serious, but that is why we need intense sampling. An intense effort to measure fecundity is being made. Batch spawning is not the major problem; assuming that eggs less than a certain size don't develop or get spawned could be a serious mistake. We will be looking at eggs down to 0.1mm.

Q: Is there any plan or commitment in the long term for use of the Wieczo for this work?

A: No. It is not anticipated to be done every year. One or two or three years may be desirable, but no commitments have been made, as was the case for the shark sampling done last year. We may need to make a communication bridge for this type of long term research, as well as the shorter term topics done in the past.

Q: What type of precision is anticipated for the estimates from this project?

A: About 20% for eggs. Fecundity is another story, but we expect about 25% since an intense effort is being made.

Q: Given that we have two techniques, VPA and eggs, will we be able to validate either one?

A: We can identify areas of concern or error. If the egg based estimate is low, then fecundity could be viewed as a major problem. If it is high, however, look to other sources of error such as catchability of adults. In 1977 the egg derived estimate was 90% of NEFC's VPA estimate, and we knew that the eggs were undersampled. It was noted that was a time of high fishing mortality and the VPA was probably pretty good.

Q: If the egg densities inside 3 miles are very high, could the undersampling in the near coastal areas be a serious problem?

A: DELAWARE II will go closer to shore next May.

Q: But, is that probably too early?

A: Given the large area of spawning, missing some of the inshore area should not be a very serious problem overall.

Q: We did have a similar gap in herring sampling and it rang a bell.
A: In 1977 we did sample close in near Narragansett Bay and Martha's Vineyard, but not Nantucket shoals.

Q: Are any other observations being made to be tied to these?
A: Other ichthyioplankton surveys are being done and will be available.

Q: Are all species being looked at or just mackerel in the samples?
A: For immediate use, just mackerel. This will double our ichthyioplankton sampling for the year. We don't plan to go back and reanalyze these samples, but they would be available to others who want to.

Q: If the samples are in Poland, how would one get them?
A: The samples are returned after sorting. About 4000-5000 sample jars have been sorted in Poland each year, but, probably less than that now.

Q: When will the SSB estimates be available?
A: In about six months.

Q: Sette followed the mackerel larvae for 90 days. Will we be able to do the same?
A: We will follow them into June, so for at least a few months if not a full 90 days.

7. INSHORE RESEARCH PLAN

No written report was prepared of presentation. The executive summary of the draft NEFC Inshore Research Program, Part 1, General Framework, is reproduced here to summarize the presentation.

"The role of the National Marine Fisheries Service's (NMFS) Northeast Fisheries Center in inshore waters is to integrate scientific information to support fishery conservation and management goals and objectives for species that move between inshore and offshore (beyond three miles) habitats, or that occur alongshore over a major portion of the Atlantic coast from Maine through Virginia.

The Center's Inshore Research Program maintains a regional perspective of the status and condition of living marine resources that depend on inshore habitats, and relies heavily on cooperation with state and local governments, academia, the Atlantic States Marine Fisheries Commission (ASMFC), Regional Fishery Management Councils, other components of the National Oceanic and Atmospheric Administration (NOAA), other federal agencies, and various other public and private organizations.

The Center's Inshore Research Program focuses on addressing the threats to living resources caused by various forms of contamination (toxic chemicals, nutrient overenrichment, pathogens and disease), physical habitat alteration and loss, and fishing, and on garnering knowledge of the causes of and trends in natural system variability, so that changes related to these threats can be detected.

The program is aligned with scientific information needs that fall into four major categories: (1) data and information management, (2) habitat requirements and use, (3) fishery statistics and stock assessments, and (4) biological effects of habitat degradation.

The Plan provides criteria for choosing species and study sites, and lists products that need to be developed to accomplish the program's objectives. It also describes the various phases through which each of the major inshore research activities should progress, and provides some idea of the linkages among the objectives and products associated with each major component of the Plan.

The Plan recommends that the Center:

(1) prepare a major budget initiative for FY89 that addresses the Plan's objectives,
(2) begin consolidating present inshore research projects into a cohesive program,
(3) begin assembling and evaluating information on habitat requirements and use,
(4) continue conducting stock assessment workshops and developing a shared network of fisheries statistics data, and
(5) develop operational approaches for accomplishing the Plan's objectives, with or without additional funding (i.e., Part II of the Plan)."

Discussion

The initial draft Inshore Research Program has been reviewed and a revision is being prepared. The reaction in general has been supportive with helpful suggestions for setting priorities. Funding for the program is currently being sought. Present efforts rely largely on ad hoc participation by NEFC staff whose primary responsibilities would otherwise be offshore resources. It was emphasized that the program cannot be carried out by re-programming, but that new funds must be obtained. The program is very comprehensive, however some of the data to be included in the information management system will be collected by agencies other than NMFS.

The question of how research priorities were being set was raised. The plan is to target on species that are showing signs of stress and/or on habitat areas that exhibit serious problems. Priorities have not been set for

all aspects of the Inshore Research Program, but will be generated as the program develops and more baseline data becomes available.

A brief discussion highlighted the importance of conducting research on concepts, which provide a framework for use of the data and for providing advice. This was acknowledged as an important aspect, which will be addressed in part by integrating the data bases in a form that will encourage this type of use. The first step is to evaluate the availability and quality of existing data.

A general question was raised concerning the difficulty of characterizing habitat quality for oceanic systems. While this has been done successfully for terrestrial and wetland systems, a classification scheme has not yet been devised for estuarine or oceanic environments. This is an area where progress is both mandatory and expected. A classification scheme is now being developed for the great lakes as part of modeling efforts on those systems; the next logical step is to formulate characterizations for estuarine habitats.

It was noted that mitigation efforts inevitably result in net habitat loss unless they can be coupled with enhancement programs which can compensate for the losses. This issue was raised because one of the Inshore Research Program's functions will be to provide advice on mitigation and enhancement techniques.

VI. RESEARCH AND MANAGEMENT PRIORITIES

There are two separate questions: (1) What are the management priorities that require additional research, and from the scientists' perspective, (2) what research needs to be done to provide the needed information? This is an important exercise because these research plans will increasingly be used to focus assessment work. This will become more important in the future. It is important to make longer term plans so research is done well. There has to be some ability to respond to immediate needs.

Mid-Atlantic FMC:

MAFMC management and scientific priorities are summarized in Table VI.1.

Black sea bass was noted as also being important to Massachusetts. The biggest problem is the hermaphroditic life history, which will require additional biological and analytical studies.

Access to the Recreational Data base has improved greatly recently, and further use of these data needs to be made.

Conservation Engineering approaches need to be addressed to evaluate increased efficiency of separator trawls and other "savings gear".

A sea sampling program seems useful to many problems. This needs to be a state/federal cooperative project because it would require a lot of people and dollars. The importance and focus of such a program needs to be evaluated, and might include discard practices, mesh selectivity and effect of fishing effort. It would be particularly useful for obtaining more information on spatial and temporal stock dynamics, gear activity and fishing behavior. It was noted to be an extremely difficult logistics problem. Alternate approaches that might provide some of this information were discussed, including Captain's log books and enhance interview sampling of offshore fishermen. Possible biases were noted if one only goes out on boats that are cooperative. Working Group #12 was formed to evaluate the scientific aspects of sea-sampling. Terms of reference and members are defined in Section IV.6.

New England FMC:

New England Fishery Management Council priorities were described in Marchesseault (1986). The priorities are more general than those discussed by MAFMC staff, and for stock assessment work focus on improving dynamic models for evaluating regulatory impact. Recent work by NEFC on dynamic models for lobster were noted as meeting these types of needs. Overlap in activities by many people was noted. Many different motivations are driving the approaches people use, but the possibility of increased joint work to develop at least components of models was noted.

Regional Office:

Several questions were noted as being important, including:

discard mortality;
discard amounts;
conservation closure areas - do they work?
effects of trawling on benthic organisms (esp. lobster);
what happens to unreported landings and what is the quantity;
sea sampling, multispecies fishery;
temporal and spatial analysis of stocks;
switching behavior of fishermen;
estuarine species, especially important to habitat and pollution;
research priorities of Atlantic salmon and striped bass;
large pelagics, particularly catch effort and age structure of the swordfish;
recreational survey data needs.

There was an extended discussion of the reporting procedures for tuna and swordfish. Mandatory reporting forms on bluefin catch do not include effort while mandatory swordfish logbooks do. The desirability and difficulty of standardizing such information was discussed. It was reported that SEFC has taken primary responsibility for developing ageing information for swordfish and for estimating age composition of USA landings. Also, NEFC is obtaining additional information on the recreation fishery for large pelagics.

Port interview sampling more generally was discussed, including the degree of coverage, the actual questions asked, and how this relates to the 3-tier system. Working Group #13 was formed to review the adequacy, accuracy and precision of the interview process, as described in Section IV.7.

Several states reviewed their research and management priorities informally. Massachusetts representatives noted their ongoing trawl survey work, and studies of discard mortality in trawl fishing. North Carolina representatives noted their interest in continuing involvement in cooperative stock assessments. They have a tagging program on summer flounder, and may be involved with TED evaluation. Connecticut representatives noted their ongoing trawl survey work, and their interest in winter flounder and scup. Winter flounder is a high priority species to Connecticut, and considerable biological research is ongoing. There may be a problem in ageing for the inshore populations. The Mystic Workshop on the biology of winter flounder deliberately excluded stock assessments in favor of the biological work. The SAW should review the results of workshops such as that so that the full range of biological research can be accounted for in developing assessments.

Wallop-Breaux funds can be used for assessments and some states are doing so. However, at present most states are using this money to improve recreational fishery data. There is an interstate, relatively near shore, management program using Wallop-Breaux funds sponsored by ASMFC.

Northeast Fisheries Center:

Research priorities and directions were reviewed briefly. Status and priority for summer flounder, long-term yield, and the Polish Cooperative research were brought up for clarification. Additional discussion of the priorities reflected occurred in development of future SAW terms of reference, and is discussed in Section VII.

Table VI.1. MAFMC FMP Development and Implementation, Monitoring, and Coordination Schedule.

FMP	1986	1987	1988	1989	1990
Surf Clam & Ocean Quahog	1a, 4	2a,3a,4	4	4	4
Atlantic Mackerel, Squid, & Butterfish	4	1a,2a,4	2a,3a,4	4	4
Bluefish	-	1,2	2,3	4	4
Atlantic Demersal Finfish	#	#	#	#	#
Striped Bass		5	5	5	5
Summer Flounder	2	2,3	4	4	4
Tilefish	-	-	1,2	2,3	4
Scup, Black Sea Bass, & Summer Flounder	-	-	1,2	2,3	4
Dogfish	-	-	-	1,2	2,3
Pelagic Sharks	5	5	5	5	5
Weakfish	-	-	-	1,2	2,3
Shad & River Herring	-	-	-	-	1,2
Menhaden	-	-	-	-	1,2
Pelagics (swordfish & billfish)	#	#	#	#	#
Lobster	*	*	*	*	*
Sea scallops	*	*	*	*	*
FMP development					
Bluefish	-	1,2	2,3	4	4
Striped Bass		5	5	5	5
Summer Flounder	2	2,3	4	4	4
Tilefish	-	-	1,2	2,3	4
Scup, Black Sea Bass, & Summer Flounder	-	-	1,2	2,3	4
Dogfish	-	-	-	1,2	2,3
Pelagic Sharks	5	5	5	5	5
Weakfish	-	-	-	1,2	2,3
Shad & River Herring	-	-	-	-	1,2
Menhaden	-	-	-	-	1,2
FMP implementation and monitoring					
Surf Clam & Ocean Quahog	1a,4	2a,3a,4	4	4	4
Atlantic Mackerel, Squid, & Butterfish	4	1a,2a,4	2a,3a,4	4	4
Coordination					
Atlantic Demersal Finfish	#	#	#	#	#
Pelagics (swordfish & billfish)	#	#	#	#	#
Lobster	*	*	*	*	*
Sea scallops	*	*	*	*	*

Codes for events: (an "a" after the number indicates an amendment)

1. Identify need for management, determine if an FMP (or amendment) is required, & specify objectives (see II.A & B of MAFMC FMP Policy).
2. Develop alternative management measures & prepare FMP (or amendment) (see II.C D of MAFMC FMP Policy).
3. Hold hearings, review public hearing comments, & prepare final FMP (or amendment) (see II.E, F, & G of MAFMC FMP Policy).
4. Council annual review of FMP, including annual quota recommendations.
5. Review to determine if FMP development should be initiated. Schedule would need to be amended if FMP is to be developed. - No work scheduled.

* Work cannot be scheduled at this time.

\# Work cannot be scheduled at this time, but substantial resources will be needed.

Schedule assumptions (if assumptions are proven wrong, schedule must be changed accordingly): (1) Striped Bass FMP will not be developed during the planning period; (2) Pelagic Sharks FMP will not be developed during planning period; (3) all new FMPs done as framework plans.

VII. TIMING AND TERMS OF REFERENCE FOR FUTURE SAWS

The timing and topics of the first three Stock Assessment Workshops was reviewed (Table VII.1). The importance of the increased participation by state biologists and the conflicts with the field programs of different participants during the May and September time frames of the 2nd and 3rd SAWs were noted. Several factors were identified that needed to be considered in selecting a better time for fall workshops. Massachusetts participants conduct their fall survey from just after Labor Day through late September. The American Fisheries Society meeting will occur in mid-September. ICATT will involve large pelagic researchers from SEFC from October 7 through the end of October. The ICES statutory meeting will be the first week in October. ASMFC and ASMFC will meet jointly around the 5th of October. MAFMC and NEFMC meetings are not scheduled that far in advance, but tend to occur every 6 weeks. Conflicts with such meetings this year apparently reduced participation by some Council staff members.

Quota management advice needs to be given on surf clams and quahogs in mid-September, and it is desired by NEFC that the SAW review that advice. This was noted to be less of a problem this year than last because NEFC conducts surf clam surveys alternate years. These surveys are conducted in August and results are used immediately as a basis for quota management advice. If SAW timetables can not be arranged to review the quota management advice, NEFC will have to transmit it separately. This is currently being done for mackerel, where the results of the spring survey will be conveyed during the summer, updating the results of the assessment as it was reviewed during this workshop.

Taking all of the above factors into account, and noting the difficulty of obtaining and the cost of housing in the Falmouth area prior to Labor Day, the group recommended moving this meeting to the week of October 19-23, 1987.

The present late March time frame was agreed to as being the most useful for spring workshops, but could not be any later without conflicting with Connecticut's spring trawl survey program. The group recommended tentatively scheduling the 6th SAW for the week of March 28 to April 1, 1988.

The general pattern of species reviewed in the spring and in the fall was noted to be very similar to that suggested in the 1st SAW in July 1985. It was noted that any of the species listed, and indeed others such as ocean pout which was discussed during the 1st SAW but not included in the resulting species list, might be reviewed. In fact, however, regular review did not seem to be required to meet management terms of reference. It was also noted that for some species formal reviews of the status of the stocks were not appropriate. Bluefish in the 3rd and 4th SAWs, for example, has been treated as a Special Topic where the methods that were being developed for assessing the status, rather than the status of the stock itself, has been reviewed.

Species that appeared to the workshop participants to be of greatest importance for consideration in the 5th SAW were:

revised assessment of yellowtail flounder stocks,

revised assessment of bluefish, using methods reviewed in the present SAW,

revised assessment of summer flounder,

updated assessments of surf clams, ocean quahogs, cod, pollock, and shrimp only if events suggest any substantial change in status.

Species that appeared to the workshop participants to be usefully addressed in the 5th SAW as Special Topics were:

Atlantic herring, especially in reviewing larval and acoustic survey research programs in Maine, and

black sea bass, especially in reviewing approaches to assessment given the unusual life history of the species. It was noted that this species has been studied by Connecticut researchers, and the utility of the several trawl surveys has been evaluated.

Other Special Topics that were identified as being usefully discussed were:

NEFC shellfish gear and discard study, including results of planned field work and results of analysis of data collected last year,

EPA Estuary Initiative studies in Long Island Sound, especially considering the assessment implications of the biological studies on winter flounder, and

Methods of predicting impact of management measures in the multispecies trawl fishery, including review of studies by both NEFC and NEFMC staff.

Future SAW special topics that might usefully be addressed include:

Trawl impacts on lobsters, reviewing earlier work by Connecticut and ongoing work by Massachusetts,

Research direction in "conservation engineering" in the region, including fishing gear development, separator trawl and square mesh.

The duration of the SAWs was noted as an important consideration in determining participation. The commitment of an entire week, and the expectation that individuals participate throughout the meeting if at all possible, made participation difficult or impossible for some people that could contribute to the discussions. It was noted that at the present meeting the degree to which individuals had been in and out of the meeting, including the chairman, was higher than in previous meetings.

The importance of maintaining participation through the process of reviewing and approving the final draft of the report was stressed, so that an agreed upon report was available as soon after the meeting as possible. The practice of reviewing sections of the report during the course of the meeting, as had been done in earlier meetings, was discussed. Several individuals

noted that they would prefer to schedule time to do that if the meeting could thereby be shortened. It was noted that for individuals traveling from greater distances it was not of material difference if the meeting ended Thursday evening or Friday noon.

It was noted that different individuals had different degrees of interest in the details of the final report. For instance, several academics had participated effectively for portions of the 3rd and 4th SAW but did not participate in the final review of the document. The principal users of the report, the two FMCs, the several states, NMFS, and perhaps the ASMFC staff, have more direct interest. Selected representatives might be relied upon to undertake the task of finalizing the report, reducing the need for continuity of other participants.

Working Groups that will be expected to report to the 5th SAW are:

WG 9 Methods of Measuring Long-term Potential Catch,

WG 12 Sea Sampling Needs, and

WG 13 Interview Data.

Table VII.1. SUMMARY OF SPECIES AND TOPICS ADDRESSED IN NEFC STOCK ASSESSMENT WORKSHOPS
(R=REVISION, U=UPDATE, ST=SPECIAL TOPIC, WG=WORKING GROUP)

WORKSHOP	1ST	2ND	3RD	4TH	5TH	6TH
SPECIES/TOPIC	JUL 85	MAY 86	SEP 86	MAR 87	SEP 87	MAR 88
SEA SCALLOP	SPRING	U				
HADDOCK	SPRING	U		U		
REDFISH	SPRING	U				
WHITE HAKE	SPRING	U				
BUTTERFISH	SPRING	U		U		
LOLIGO SQUID	SPRING	U		U		
ILLEX SQUID	SPRING	U		U		
WITCH FLOUNDER	SPRING	U				
YELLOWTAIL FLOUNDER	SPRING	U			R	
AMERICAN PLAICE	SPRING	U		U		
SILVER HAKE	SPRING	U		R		
RED HAKE	SPRING	U				
ATLANTIC MACKEREL	FALL	R		U		
AMERICAN LOBSTER	FALL		R			
WINTER FLOUNDER (GB)	FALL		R			
SURF CLAMS	FALL		R		U	
OCEAN QUAHOG	FALL		U		U	
ATLANTIC COD	FALL		R		U	
SPINY DOGFISH	FALL					
SKATES	FALL					
TILEFISH	FALL					
POLLOCK	FALL		R		U	
CUSK	FALL					
WOLFFISH	FALL					
RED CRAB	FALL					
ATLANTIC HERRING	ASMFC?				ST	
STRIPED BASS	ASMFC?			ST		
BLACK SEA BASS	ASMFC?				ST	
BLUEFISH	ASMFC?		U	ST	R	
SCIAENIDS	ASMFC?		U			
RIVER HERRING	ASMFC?					
SUMMER FLOUNDER	ASMFC?		U	WG	R	
WINTER FLOUNDER (ESTUARY)	ASMFC?		R		ST	
NORTHERN SHRIMP	ASMFC?		U		U	
WINDOWPANE FLOUNDER						
SCUP				U		
TRAWL SURVEY REVIEW		ST	ST			
BLUEFISH AGEING METHODS			ST			
LONG TERM POTENTIAL CATCH			ST	WG		
MIXED SPECIES EFFORT				ST		
SHELLFISH GEAR DISCARD, SELECTIVITY				ST		
RECREATIONAL SURVEY DATA				ST		
EXPERIMENTAL MACKEREL FISHERY				WG		
CATCHABILITY COEFF. CHANGES				WG		
ICTHYIOPLANKTON ASSESSMENT OF MACKEREL				ST		
NEFC INSHORE RESEARCH PLAN				ST		
METHODS PREDICTING IMPACT MGMT. MEASURES IN MULTI-SPECIES TRAWL FISHERIES					ST	
SSB/R CALCULATIONS - TMG					ST	
RES. DIR. - CONSERV. ENGINEERING					ST	

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IX. APPENDIX

DRAFT AGENDA FOR 4TH NEFC STOCK ASSESSMENT WORKSHOP

March 30 to April 13 1987
NORTHEAST FISHERIES CENTER
MBL CANDLE HOUSE
WOODS HOLE, MA

CONTACT: TIM SMITH, 617-548-5123

MONDAY MARCH 30

1300 INTRODUCTIONS
WELCOME CENTER DIRECTOR
ADOPTION OF AGENDA, IDENTIFICATION OF WORKING PAPERS
APPOINTMENT OF RAPPORTEURS CHAIR: TIM SMITH

1330 SAW STRUCTURE AND ROLE IN PROVIDING ASSESSMENT ADVICE
CHAIR:

REVIEW OF MID-ATLANTIC FISHERIES RESOURCES SPECIES:
CHAIR: BILL OVERHOLTZ

1400 UPDATED BUTTERFISH ASSESSMENT -- GORDON WARING - T. SMITH

1430 UPDATED MACKEREL ASSESSMENT -- BILL OVERHOLTZ - A. LANGE

1500 **SPECIAL TOPIC:**
MACKEREL BIOMASS ESTIMATION FROM ICTHYIOPLANKTON - MOUNTAIN
CHAIR: MARV GROSSLEIN

1530 WORKING GROUP REPORTS:
WG-5 EXPERIMENTAL MACKEREL FISHERY BILL OVERHOLTZ - M. FOGARTY
WG-10 SUMMER FLOUNDER DATA ANNE RICHARDS - SIMPSON

1700 BREAK FOR DINNER

TUESDAY MARCH 31:
REVIEW OF MID-ATLANTIC FISHERY RESOURCES SPECIES: CONTINUED

0900 UPDATED LONG-FINNED SQUID ASSESSMENT ANNE LANGE - FOSTER

0930 UPDATED SHORT-FINNED SQUID ASSESSMENT ANNE LANGE - FOSTER

1000 UPDATED SCUP ASSESSMENT PENNY HOWELL - HOWE

1100 **SPECIAL TOPIC: SHELLFISH DISCARD STUDY DEEGAN**
CHAIR: FRED SERCHUK

1200 BREAK FOR LUNCH

1330	**SPECIAL TOPIC: RECREATIONAL DATA** CHAIR: MARK TERCEIRO	TURNER
1430	**SPECIAL TOPIC: REVIEW OF BLUEFISH ASSESSMENT METHODS** CHAIR: VIC CRECCO	DEEGAN
1530	**SPECIAL TOPIC: STRIPED BASS FISHERY INDEPENDENT SURVEY DESIGN** CHAIR: ANNE RICHARDS	WARING
1600	WORKING GROUPS MEET REVIEW PAPERS	

WEDNESDAY APRIL 1:

0900 **WG 7: CHANGES IN CATCHABILITY**
CHAIR: VIC CRECCO

NEW ENGLAND FISHERY RESOURCES SPECIES
CHAIR: FRED SERCHUK

0930	REVISED ASSESSMENT OF SILVER HAKE	F. ALMEIDA
1030	UPDATE ON 1985 GB HADDOCK YEAR CLASS	B. OVERHOLTZ
1100	UPDATE ON STATUS OF AMERICAN PLAICE	W. GABRIEL
1130	BREAK FOR LUNCH	

1330 **REVIEW RESEARCH AND MANAGEMENT PRIORITIES**
CHAIR: TIM SMITH

MID-ATLANTIC FISHERY MANAGEMENT COUNCIL
NEW ENGLAND FISHERY MANAGEMENT COUNCIL
NORTHEAST REGIONAL OFFICE
STATES
NORTHEAST FISHERY CENTER

1530	WORKING GROUPS MEET RAPPORTEURS WRITE REVIEW PAPERS	
1730	SOCIAL HOUR	

THURSDAY APRIL 2

0900 **SPECIAL TOPIC: MEASURING EFFORT IN MIXED SPECIES FISHERIES**
CHAIR: FRED SERCHUK

1030 **SPECIAL TOPIC: INSHORE RESEARCH PLAN**
CHAIR: JOHN BOREMAN

1100 **WG 9: METHODS OF MEASURING LONG-TERM POTENTIAL CATCH**
CHAIR: BRIAN ROTHSCHILD

1200 BREAK FOR LUNCH

1330 WG 9: CONTINUED IF NEEDED

TERMS OF REFERENCE FOR FUTURE SAWS
CHAIR: TIM SMITH

1430 FINALIZE MANAGEMENT TERMS OF REFERENCE FOR 5TH SAW

1500 FINALIZE SCIENTIFIC TERMS OF REFERENCE FOR 5TH SAW

1530 RECOMMEND TERMS OF REFERENCE FOR 5TH SAW
PRELIMINARY TERMS OF REFERENCE FOR 6TH SAW

1545 **BEGIN FINALIZING MEETING REPORT**
CHAIR: TIM SMITH

1700 BREAK FOR DINNER

FRIDAY APRIL 3:

0900 **FINALIZE MEETING REPORT**
CHAIR: TIM SMITH

1200 ADJOURN

ST:	SPECIAL TOPIC
REVISED ASSESSMENT:	SUBSTANTIALLY REVISED STOCK ASSESSMENT
UPDATED ASSESSMENT:	CATCH AND SURVEY DATA BROUGHT UP TO DATE
WG:	WORKING GROUP ESTABLISHED BY SAW