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by

Jon A. Gibson

The United States (US) landed fish from, and conducted research in, ICNAF Subareas 3[a], 4, and 5, and Statistical Area 6. Table 1 gives a summary of US finfishes, squids, and sea scallop nominal catches in 1976 and 1977.

Table 1. US finfishes, squids, and sea scallop nominal catches for 1976[a] and 1977 [metric tons (MT), round fresh].

Species	Year	Subarea or Statistical Area 4	5	6	Total
Haddock	1976[a]	1,018	4,769	2	5,789
	1977	1,663	11,231	1	12,895
Atlantic cod	1976	346	24,664	414	25,424
	1977	762	33,248	317	34,327
Redfish	1976	4,446	10,131	-	14,577
	1977	2,875	13,011	-	15,886
Pollock	1976	619	10,241	3	10,863
	1977	320	12,722	7	13,049
Yellowtail flounder	1976	12	16,900	254	17,166
	1977	13	16,054	535	16,602
Other flounder	1976	74	17,617	9,821	27,512
	1977	64	23,049	9,900	33,013
Silver hake	1976	1	17,435	5,628	23,064
	1977	14	15,504	6,425	21,943
Red hake	1976	3	2,660	1,899	4,562
	1977	4	2,292	1,118	3,414
Atlantic herring	1976	-	49,953	189	50,142
	1977	-	50,607	46	60,653
Atlantic mackerel	1976	-	1,311	1,401	2,712
	1977	-	694	682	1,376
River herring[b]	1976	-	1,592	4,890	6,482
	1977	-	1,678	4,793	6,471
Menhaden	1976	-	40,466	257,426	297,892
	1977	-	14,050	248,821	262,871
Butterfish	1976	-	774	754	1,528
	1977	-	774	674	1,448

* Executive Secretary, ICNAF, P. O. Box 638, Dartmouth, Nova Scotia, Canada B2Y 3Y9

Other finfishes	1976	535	14,820	37,192	52,547
	1977	272	21,164	42,596	64,032
Total finfish	1976	7,054	213,333	319,873	540,260
	1977	5,987	216,078	315,915	537,980
(*Loligo* sp.) squid	1976	-	1,118	112	1,230
	1977	-	778	68	856
(*Illex* sp.) squid	1976	-	223	6	229
	1977	4	1,008	14	1,026
sp. not specified squid	1976	-	1,333	1,039	2,372
	1977	-	110	564	674
Sea scallop[c]	1976	-	17,877	54,777	72,654
	1977	-	43,299	48,579	91,878

[a]1976 values revised.
[b]Combined alewife and blueback herring.
[c]In-the-shell weights.

I. SUBAREA 4

A. Status of the Fisheries

1. Haddock

US landings and landings per day fished for Division 4X increased substantially from 1976 to 1977 (Table 2). The young-of-the year (YOY) abundance index also increased slightly.

Table 2. US haddock statistics, Division 4X (MT, round fresh).

	Division 4X		Browns Bank		
Year	Landings	YOY index[a]	Landings	Days fished	Landings/day fished[b]
1966	2,473	1.3	939	200	4.7
1967	5,014	1.1	2,059	381	5.4
1968	3,156	1.5	2,278	506	4.5
1969	1,830	3.3	1,305	389	3.4
1970	1,744	1.0	1,576	493	3.2
1971	751	6.1	605	242	2.5
1972	448	2.3	387	117	3.3
1973	269	1.8	268	107	2.5
1974	670	2.9	648	-[c]	-[c]
1975	2,143	4.5	2,098	477	4.4
1976	986	3.5	904	181	5.0
1977	1,663	3.6	1,214	164	7.4

[a]Mean number of YOY haddock caught per survey tow taken from the linear scale retransformed from the $\log_{10}$ scale.
[b]Calculated from catch and effort data for large [≥151 gross (English) tons(GT)] otter trawlers from the Port of Boston, Massachusetts.
[c]Landings and landings per day fished were not calculated due to a 10% trip limitation.

2. Atlantic cod

The US fleet landed 762 MT of Atlantic cod from Subarea 4 in 1977, 416 MT more than in 1976.

B. Special Research Studies

1. Environmental Studies

Northeast Fisheries Center scientists have shown through the deployment and retrieval of current meters that the amount of high-salinity, nutrient-rich water in the Gulf of Maine is related to the inflow of water through the Northeast Channel.

2. Miscellaneous Studies

The semiannual research vessel surveys by the Northeast Fisheries Center were continued in 1977. Table 2 shows a relatively large index for YOY haddock taken in Division 4X during those surveys.

The Maine Department of Marine Resources collected and analyzed blood samples from anadromous finfish to determine the incidence and distribution of P.E.N., a viral blood infection. The virus was found in 14 commercially important species.

II. SUBAREA 5

A. Status of the Fisheries

1. Haddock

US commercial haddock landings in Subarea 5 increased sharply over 1976 levels (Table 3) in spite of a 6,000-MT incidental catch limitation. This may be attributed primarily to recruitment of the 1975 year class which appears to have been strong in Divisions 5Y and 5Z. The US autumn research vessel trawl survey abundance index for Georges Bank (Subdivision 5Ze) increased sharply in 1976 and remained stable in 1977 (Table 4). However, the Georges Bank YOY abundance index was considerably lower in both 1976 and 1977 than in 1975, suggesting that subsequent year classes have again been weak (Table 4).

Table 3. US haddock statistics, Subarea 5 (MT, round fresh).

Year	Division 5Y landings	Subdivision 5Ze landings	Subdivision 5Zw landings	Total landings for Subarea 5
1966	4,579	52,887	31	57,497
1967	4,907	34,691	37	39,635
1968	3,437	25,197	272	28,906
1969	2,423	16,443	13	18,879
1970	1,457	8,400	15	9,872
1971	1,194	7,301	5	8,500
1971	909	3,866	3	4,778
1973	509	2,776	1	3,286
1974	622	2,396	0	3,018
1975	1,180	3,973	16	5,169
1976	1,865	2,902[a]	2	4,769
1977	3,323	7,902[a]	6	11,234

[a]Subarea 5 landings from unknown divisions or subdivisions assigned to Subdivision 5Ze

Table 4. US haddock statistics, Subdivision 5Ze.

Year	Survey index[a]	YOY index[b]
1966	19.8	1.7
1967	15.3	1.0
1968	10.2	1.1
1969	5.6	1.1
1970	8.9	1.0
1971	3.7	1.4
1972	5.6	2.1
1973	6.5	1.8
1974	2.6	1.3
1975	10.0	3.8
1976	23.7	1.7
1977	23.1	1.1

[a]Stratified mean catch per survey tow in kilograms.
[b]Mean number of YOY haddock caught per survey tow taken from a linear scale retransformed from the $\log_{10}$ scale.

2. Atlantic Cod

US commercial landings of Atlantic cod from Subarea 5 in 1977 increased by about 34% from 1976 (Table 5). Total catches by all countries in recent years have been high, exceeding or being close to the sustainable yield. US commercial landings per day fished from Georges Bank (Subdivision 5Ze) have increased significantly; however, this is probably a reflection of changes in fishing practices (i.e., a greater directed fishery for Atlantic cod in the absence of haddock). The US autumn research vessel survey abundance index showed a slight decrease from 1976.

Table 5. US Atlantic cod statistics, Subarea 5 (MT, round fresh).

Year	Division 5Y landings	Division 5Z: Subdivision 5Zw landings	Division 5Z: Subdivision 5Ze: Landings	Division 5Z: Subdivision 5Ze: Landings /day fished	Division 5Z: Subdivision 5Ze: Survey index[a]	Total landings for Sub-area 5
1966	4,008	345	10,990	1.1	11.1	15,343
1967	5,527	684	11,846	1.0	18.5	18,057
1968	6,360	836	13,849	1.4	11.7	21,045
1969	7,823	1,143	15,209	1.6	10.9	24,175
1970	7,812	1,182	13,353	2.1	17.1	22,347
1971	7,380	796	14,999	2.0	13.4	23,175
1972	6,564	662	12,478	2.6	31.3	19,704
1973	6,063	1,092	14,846	4.2	42.0	22,001
1974	7,426	1,220	16,645	3.9	11.2	25,290
1975	8,676	644	14,594	3.8	19.1	23,915
1976	9,879	280	13,940	3.9	24.0	24,664
1977	12,896	775	19,577	5.6[b]	22.9	33,248

[a]Stratified mean catch per survey tow in kilograms.
[b]Provisional values for January through October.

3. Redfish

US commercial redfish landings from Subarea 5 increased by 28% in 1977 (Table 6). The landings per day fished in the Gulf of Maine (Division 5Y) also increased for the second year in a row. Much of this increase can be attributed to continued recruitment of the relatively young 1971 year class.

Table 6. US redfish statistics, Subarea 5 (MT, round fresh).

Year	Division 5Y: Landings	Division 5Y: Days fished	Division 5Y: Landings/day fished	Total landings for Subarea 5
1966	4,719	429	11.0	7,204
1967	6,746	649	10.4	10,442
1968	4,060	292	13.9	6,576
1969	9,637	824	11.7	12,038
1970	13,551	1,473	9.2	15,534
1971	12,541	1,695	7.4	16,267
1972	7,150	1,132	6.3	13,161
1973	7,008	1,168	6.0	11,922
1974	5,464	1,012	5.4	8,690
1975	5,961	1,362	4.4	9,075
1976	7,985	1,705	4.7	10,131
1977	9,854	1,964	5.2	13,004

Redfish stock abundance indices (Table 7) from autumn research vessel surveys for the Gulf of Maine (Division 5Y) indicate a stabilization of this stock, partially as a result of increasing availability of the 1971 year class.

Commercial and research survey length-frequency samples indicate continued availability of this year class with a modal length of 22 cm in the autumn of 1977 in the inshore Gulf of Maine strata.

On Georges Bank (Subdivision 5Ze), the indices have fluctuated considerably in recent years, but the long-term trend in abundance appears to be relatively stable.

Table 7. US redfish survey indices, Division 5Y and Subdivision 5Ze.[a]

	Division 5Y		Subdivision 5Ze	
Year	Weight(lb)	Number	Weight(lb)	Number
1966	69.9	96.8	4.4	11.4
1967	56.7	100.8	5.8	18.3
1968	95.3	154.7	7.7	11.3
1969	47.0	66.5	14.4	17.6
1970	74.5	96.3	10.2	13.3
1971	56.0	50.8	4.1	6.2
1972	55.0	54.8	8.5	10.8
1973	38.2	39.8	5.8	6.2
1974	58.2	51.0	4.1	6.1
1975	91.1	78.8	11.4	8.0
1976	37.4	31.8	1.4	1.4
1977	32.7	38.3	12.9	9.5

[a]Stratified mean catch per survey tow in weight or numbers.

4. Yellowtail Flounder

The total US commercial catch of yellowtail flounder of 16,052 MT for 1977 has continued its trend of decline from the 1970 value of 42,608 MT (Table 8). Food landings decreased 5%, estimated discards decreased 73%, and estimated industrial landings increased 74%, from the 1976 values.

The 1977 US autumn research vessel survey abundance indices for southern New England (Subdivision 5Zw) and Georges Bank (Subdivision 5Ze) remain low (Table 9). Very weak recruitment was indicated for Georges Bank for the second consecutive year.

Table 8. US Yellowtail flounder statistics, Subarea 5 (MT, round fresh).

Year	Food landings	Estimated discards	Estimated industrial landings	Total catch
1966	28,656	8,253	2,364	39,273
1967	20,819	14,407	4,587	39,813
1968	28,645	10,627	3,939	43,211
1969	28,739	5,202	4,265	38,206
1970	29,825	10,689	2,095	42,608
1971	21,700	7,124	397	29,221
1972	23,886	3,100	327	27,313
1973	24,710	1,086	343	26,139
1974	23,145	993	22	24,160
1975	18,857	1,246	35	20,138
1976	16,538	951	15	16,900
1977	15,740	257	57	16,054

Table 9. US yellowtail flounder survey indices, Division 5Z.[a]

	Subdivision 5Y		Subdivision 5Ze	
Year	Weight(lb)	Number	Weight(lb)	Number
1963	32.1	50.6	22.0	30.1
1964	41.9	60.8	23.4	23.0
1965	28.0	38.7	15.7	15.0
1966	20.8	50.3	6.7	14.8
1967	31.0	57.7	13.0	19.2
1968	22.1	40.2	18.1	25.6
1969	31.7	54.8	16.0	23.1
1970	24.7	39.8	8.6	13.4
1971	20.2	41.7	11.0	15.2
1972	44.3	73.3	10.9	14.6
1973	5.0	7.9	9.5	13.1
1974	14.1	6.9	6.3	10.0
1975	1.6	2.9	4.0	7.7
1976	6.5	10.7	2.6	2.5
1977	3.3	5.0	5.6	5.4

[a]Stratified mean catch per survey tow in weight or numbers.

5. Silver hake

Total US commercial silver hake landings from Subarea 5 decreased from 17,435 MT in 1976 to 15,504 MT in 1977 (Table 1). After sharp increases in 1976, landings-per-day-fished indices (Table 10) decreased slightly in Division 5Y and Subdivision 5Ze. After increasing steadily for 3 yr (1974-1976), landings and landings per day fished for Class 2 vessels (0-50 GT) in Division 5Y decreased slightly. Landings and landings per day fished for Class 3 vessels (51-150 GT) in Subdivision 5Ze show the same trend as in Division 5Y. The commercial abundance indices obtained from landings and days fished data of Class 2 vessels fishing in depths less than 56 m in Subdivision 5Zw (and Division 6A) continued the slight, but steady, increase since 1974.

US silver hake abundance indices from US autumn research vessel surveys (Table 11) decreased in 1977 in all areas after steadily increasing since 1974. The abundance indices from spring surveys showed a small absolute change, but a large relative change in the southern New England-mid Atlantic stock (Subdivision 5Zw-Division 6A), a large increase in the Georges Bank stock (Subdivision 5Ze), and a large decrease in the Gulf of Maine stock (Division 5Y).

Table 10. US silver hake statistics, Subarea 5 (MT, round fresh).

	Division 5Y		Division 5Z					Total landings for Subarea 5
			Subdivision 5Ze		Subdivision 5Zw			
Year	Landings	Landings/day fished	Landings	Landings/day fished	Food landings	Landings/day fished[a]	Industrial landings	
1966	21,323	18.2	16,222	26.1	3,281	4.6	-	40,826
1967	14,390	17.1	12,692	31.8	607	5.2	3,297	80,986
1968	24,706	17.8	6,451	25.3	1,221	5.3	3,541	35,919
1969	14,609	10.1	1,654	13.3	1,429	6.2	2,809	20,501
1970	11,384	7.7	4,238	23.8	2,441	7.7	1,218	19,281
1971	8,263	8.6	3,169	17.4	1,069	4.9	923	13,434
1972	5,548	7.1	979	8.7	1,499	6.2	117	8,143
1973	8,348	9.9	5,704	22.6	1,129	4.8	795	15,976
1974	4,634	6.3	2,285	15.0	1,946	4.3	669	9,534
1975	8,042	7.8	4,588	22.7	1,999	5.7	1,522	16,151
1976	9,746	16.7	3,793	46.1	2,747	6.6	1,216	17,435
1977	8,727	15.9	3,749	31.6	1,915	7.6	1,113	15,504

[a]Includes Division 6A statistics also.

Table 11. US silver hake survey indices, Subarea 5 and Division 6A.[a]

Year	Subdivision 5Zw (and Division 6A) Spring	Autumn	Subdivision 5Ze Spring	Autumn	Division 5Y Spring	Autumn
1963	-	5.2	-	3.6	-	26.5
1964	-	5.7	-	1.3	-	4.7
1965	-	7.6	-	1.5	-	7.9
1966	-	3.6	-	1.5	-	4.3
1967	-	4.4	-	1.1	-	2.4
1968	7.4	4.8	0.4	2.5	<0.1	1.9
1969	3.8	2.3	0.5	1.7	0.2	2.4
1970	1.7	2.6	0.7	1.3	0.3	3.0
1971	3.7	4.6	0.8	1.2	0.4	2.7
1972	2.3	4.0	0.5	1.3	1.7	6.5
1973	1.2[b]	3.2	0.8[b]	1.8	0.7[b]	4.2
1974	1.7[b]	1.4	0.3[b]	1.1	0.7[b]	3.8
1975	3.1[b]	2.8	0.4[b]	2.0	2.4[b]	9.1
1976	2.0[b]	3.9	0.4[b]	4.4	2.4[b]	10.9
1977	1.2[b]	3.1	1.3[b]	1.9	1.0[b]	7.2

[a]Stratified mean catch per survey tow in kilograms.
[b]Spring survey cruises made with Yankee No. 41 trawl have been adjusted to the Yankee No. 36 trawl.

6. Red Hake

Red hake commercial landings from Subarea 5 in 1977 decreased slightly (Table 12). The 1977 US autumn research vessel survey abundance index indicated relatively little change in the stock for the Gulf of Maine (Division 5Y), Georges Bank (Subdivision 5Ze), and southern New England (Subdivision 5Zw) (Table 13).

Table 12. US red hake statistics, Subarea 5 (MT, round fresh).

	Food fish		Industrial fish		
Year	Division 5Y landings	Subdivision 5Ze landings	Subdivision 5Zw landings	Landings /day fished	Total landings for Subarea 5
1966	634	845	2,801	2.3	4,280
1967	92	169	5,498	5.6	5,759
1968	82	161	5,973	7.0	6,216
1969	140	225	4,558	8.2	4,923
1970	249	100	3,932	6.3	4,281
1971	268	111	2,404	8.4	2,783
1972	373	160	1,178	-	1,711
1973	286	77	2,577	-	2,940
1974	407	81	1,399	-	1,887
1975	394	55	1,310	-	1,760
1976	618	37	2,014	-	2,660
1977	802	96	1,393	-	2,292

Table 13. US red hake survey indices, Subarea 5.[a]

			Division 5Z			
	Division 5Y		Subdivision 5Ze		Subdivision 5Zw	
Year	Spring	Autumn	Spring	Autumn	Spring	Autumn
1963	-	4.9	-	7.9	-	8.4
1964	-	0.7	-	2.6	-	4.4
1965	-	10.0	-	2.1	-	5.6
1966	-	0.7	-	1.4	-	2.9
1967	-	0.4	-	0.7	-	2.7
1968	0.9	0.1	0.3	1.3	1.9	4.4
1969	0.5	0.0	0.4	1.8	1.7	4.8
1970	0.4	0.1	0.4	1.0	2.4	3.9
1971	0.5	1.0	1.5	2.1	5.4	3.4
1972	1.3	1.9	1.1	1.2	5.6	6.6
1973	1.2[b]	0.6	0.6[b]	3.0	2.1[b]	3.1
1974	0.7[b]	0.5	0.2[b]	1.6	1.6[b]	0.6
1975	1.2[b]	1.0	0.4[b]	7.6	1.4[b]	4.3
1976	1.0[b]	1.1	0.5[b]	4.4	3.5[b]	3.4
1977	0.2[b]	2.8	0.1[b]	5.0	0.9[b]	3.2

[a]Stratified mean catch per survey tow in kilograms.
[b]Spring surveys made with Yankee No. 41 trawl have been adjusted to the Yankee No. 36 trawl.

7. Atlantic Herring

US Atlantic herring catch in Division 5Y increased slightly, due primarily to increased catches in the juvenile fishery. Concentrations of spawning herring did not appear on the traditional autumn spawning grounds in Division 5Y or on Georges Bank (Subdivision 5Ze). This resulted in a severe decline in the Division 5Y adult fishery catch and a total collapse of the Georges Bank (Subdivision 5Ze) fishery (Table 14).

The US autumn and spring research vessel survey abundance indices still remain extremely low (Table 5).

Table 14. US Atlantic herring statistics, Subarea 5 (MT, round fresh).

Year	Division 5Y landings	Division 5Z Subdivision 5Ze landings	Division 5Z Subdivision 5Zw landings	Total landings for Subarea 5
1966	29,365	1,224[a]	-	30,589
1967	31,158	620[a]	-	31,158
1968	41,476	9	598	42,083
1969	28,687	832	1,261	30,780
1970	29,181	272	1,031	30,484
1971	31,491	1,194	1,205	33,890
1972	38,211	11	2,251	40,473
1973	21,601	162	3,912	25,675
1974	29,356	171	2,866	32,392
1975	31,591	3	4,088	35,681
1976	49,398	40	507	49,953
1977	50,291	1	315	50,607

[a]Division 5Z.

Table 15. US Atlantic herring survey indices, Division 5Z.[a]

Year	Subdivision 5Ze autumn survey	Subdivision 5Zw spring survey
1963	7.0	-
1964	1.1	-
1965	6.5	-
1966	10.4	-
1967	3.3	-
1968	1.4	120.6
1969	1.1	45.8
1970	0.7	34.7
1971	0.6	4.1
1972	1.1	5.7
1973	1.1	7.2
1974	1.1	2.1
1975	0.1	0.1
1976	0.1	0.2
1977	0.0	0.4

[a]Stratified mean catch per survey tow in numbers.

8. Atlantic Mackerel

US Atlantic mackerel landings declined in Subarea 5 in 1977 (Table 6). US commercial landings per standardized day fished for the entire stock (Subarea 5 and Statistical Area 6) declined in 1977 to 0.5 MT per day, after increasing to 0.6 MT per day in 1976. US autumn and spring research vessel survey abundance indices in 1977 show slight decreases in both the spring and autumn (Table 7).

Table 16. US Atlantic mackerel statistics, Subarea 5 (MT, round fresh).

Year	Landings	Landings/standard day fished[a]
1964	1,264	0.4
1965	1,467	0.5
1966	1,903	0.8
1967	3,216	1.8
1968	3,001	2.8
1969	3,873	1.9
1970	3,092	2.1
1971	1,593	1.3
1972	1,025	0.8
1973	621	0.5
1974	475	0.2
1975	547	0.5
1976	1,044	0.6
1977	694	0.5

[a]Includes Statistical Area 6 values also.

Table 17. US Atlantic mackerel survey indices, Subarea 5.[a]

Year	Spring	Autumn
1965	-	0.1
1966	-	0.1
1967	-	0.4
1968	4.0	0.2
1969	0.1	0.5
1970	2.0	0.1
1971	2.0	0.1
1972	1.3	0.1
1973	0.7	<0.1
1974	0.8	0.1
1975	0.3	<0.1
1976	0.3	<0.1
1977	0.2	<0.1

[a]Stratified (spring strata = 1-25 and 61-76; autumn strata = 1,2,5,6, 9,10,13,16,19-21,23,25, and 26) mean catch per survey tow in kilograms.

9. Industrial Groundfish Fishery

Landings for industrial purposes from Subarea 5 (predominantly Subdivision 5Zw) increased in 1977 (Table 18).

Table 18. US landings from Subarea 5 for industrial purposes (MT, round fresh).

	Total	Species composition (%) for Subdivision 5Zw				
Year	landings	Silver hake	Red hake	Flounders	Ocean pout	Others
1966	27,461	9.6	10.2	18.2	25.0	37.0
1967	37,400	10.2	14.7	18.5	18.9	37.7
1968	34,729	9.9	17.2	16.5	24.2	32.2
1969	26,813	9.5	17.0	21.3	20.8	31.4
1970	20,696	6.3	17.9	16.7	28.3	30.8
1971	8,823	10.1	25.8	6.6	33.7	26.3
1972	5,944	2.1	17.9	10.3	35.3	35.8
1973	11,854	7.4	20.8	10.4	26.2	35.2
1974	10,121	7.0	12.9	5.0	29.6	45.5
1975	4,250	35.8	22.2	8.8	4.9	28.3
1976	4,012	30.3	39.2	5.5	1.8	23.2
1977	4,292	25.9	27.9	6.7	7.3	32.2

10. Sea Scallops

US sea scallop landings reached their highest level since 1962 (Table 19). Effort increased significantly and, with the continued presence of the strong year class recruited in 1976, catch also increased.

Table 19. US sea scallop statistics, Subarea 5 (MT of meats).

Year	Landings	Days fished	Landings/ day fished
1966	994	1,104	0.9
1967	1,309	1,870	0.7
1968	1,163	1,938	0.6
1969	1,991	3,980	0.5
1970	1,553	2,588	0.6
1971	1,697	3,394	0.5
1972	1,347	2,694	0.5
1973	1,543	2,572	0.6
1974	1,153	1,647	0.7
1975	1,650	2,062	0.8
1976	2,061	1,825	1.1
1977	5,003	4,011	1.2

B. Special Research Studies

1. Environmental Studies

a) Hydrographic studies

At the Northeast Fisheries Center scientists are looking into subsurface currents and water temperatures in Subarea 5.

The Atlantic Environmental Group continued its efforts to monitor variations in the marine environment in Subarea 5. Particular attention was given to satellite imagery showing warm-core eddies from the Gulf Stream, which profoundly change the fishery environment of the outer continental shelf and slope region as they move along it from Georges Bank to Cape Hatteras.

Continuous recordings of air temperature, sea surface temperature, sea bottom temperature, salinity, barometric pressure, and precipitation were taken by the Maine Department of Marine Resources, and reduced to monthly averages at the Boothbay Harbor Laboratory. Tide level, wind speed, wind direction, and dew point were recorded and stored without reduction. The mean annual sea surface temperature for 1977 was 8.7°C. This was the second year of decline from the 1975 high of 9.4°C.

b) Plankton studies (including eggs and larvae)

On Georges Bank the smallest number of Atlantic herring larvae was recorded since the Northeast Fisheries Center began larval Atlantic herring surveys in 1971. Also, on Georges Bank there was the fourth straight year of large catches of sand lance. Sand lance are important forage for major commercial and recreational fishes, but as larvae they might also be severely outcompeting for food the larvae of those same commercial and recreational fishes. In fact, in 1977 low numbers of Atlantic cod, haddock, and pollock larvae were recorded on Georges Bank.

The annual spring (March-April) survey to determine the distribution and abundance of larval Atlantic herring along the Maine coast was completed in Division 5Y by the Maine Department of Marine Resources. Larvae were also sampled periodically from October to March in the Sheepscot estuary.

c) Benthic studies

The commercial sea scallop (*Placopecten magellanicus*) catch in Division 5Y was sampled for age and growth studies along the Maine coast by the Maine Department of Marine Resources. A total of 3,000 scallops was tagged and released. Returns from the commercial fishery will be analyzed for age and growth.

Nearshore areas along the southern Maine coast were surveyed by the Maine Department of Marine Resources to determine the abundance of ocean quahogs (*Arctica islandica*) and surf clams (*Spisula solidissima*).

The marine worm project of the Maine Department of Marine Resources initiated and completed several studies during 1977 in Division 5Y. One was the effects of chlorinated sewage effluent upon marine worms and another was the effect of salinity changes upon the weight and volume of various sizes of sandworms and bloodworms.

An assessment cruise was made in August in the northern Gulf of Maine area by the Maine Department of Marine Resources to obtain estimates of stock size and mortality by year class for the northern shrimp (*Pandalus borealis*).

In the spring of 1975 a total of 2,882 lobsters (*Homarus americanus*) were tagged at three locations off the Maine coast by the Maine Department of Marine Resources. A total of 2,188 of these lobsters has been captured through September 1977. Estimates of catchability and movement by sex were made.

Monitoring of the green crab (*Carcinus maenas*) population along the Maine coast was continued by the Maine Department of Marine Resources for Subdivision 5Y. Monthly trapping and periodic field surveys indicate an overall decline in abundance for the second consecutive year. This crab, whose abundance is correlated with recent increases in temperature, has been devastating the soft clam (*Mya*) population in southwestern Maine.

d) Other environmental studies

The Northeast Fisheries Center began the Ocean Pulse Program, an effort to assess and monitor environmental conditions along the Northwest Atlantic's continental shelf. Operational test phase cruises made collections and analyses at contaminated and uncontaminated stations. Analyses were done at sea with instruments normally only used in the laboratory and experiments were conducted on organisms native to the sampling stations.

Northeast Fisheries Center scientists played a key role in the study of the effects of the sinking of the oil tanker, Argo Merchant. Biochemical, environmental, and physiological measurements were made of biological materials collected during and after the release of oil from the vessel. These preliminary data suggested, but did not confirm, that the crude oil had had an effect on selected fish and shellfish.

The point source pollution survey by the Maine Department of Marine Resources was continued in Division 5Y. Its purpose is to monitor all coastal discharges, both domestic and industrial, in shellfishing areas. Ocean outfalls are located and evaluated, owners are identified, and in some cases the receiving water quality is tested.

The monitoring of shellfish for the presence of coliform bacteria and red tide toxins in Division 5Y was also continued by the Maine Department of Marine Resources.

A cooperative research project in Division 5Y by the Maine Department of Marine Resources with Bigelow Laboratory was continued. The primary purpose of this project is to secure a reliable bioassay for the red tide toxin that does not utilize experimental animals.

The Massachusetts Division of Marine Fisheries has been engaged in an environmental assessment of the Salem Power Plant since 1970. In 1977, these studies centered on monitoring ichthyoplankton densities within Salem Harbor and Salem Sound and benthic fishes in Salem Sound. In addition, they also monitored intakes for finfish entrapment. The work is conducted in Division 5Y.

The Massachusetts Division of Marine Fisheries is also performing a similar environmental assessment on the Pilgrim Nuclear Power Plant. In 1977 this work involved temperature monitoring as well as lobster and Irish Moss catch-effort determinations. Benthic fishes are also sampled for assessment on a biweekly basis. This work is also performed in Division 5Y.

Additionally, the Massachusetts Division of Marine Fisheries is performing meroplankton studies and larval lobster studies in connection with the Cape Cod Canal Power Plant in the vicinity of Buzzards Bay and the Cape Cod Canal proper. The purpose of this work is to determine the abundance and distribution of both lobster larvae and ichthyoplankton in the area. Both intake and discharge are also monitored. Fish behavioral studies are also being studied on a submerged diffuser at this power plant. The work is performed in Subdivision 5Zw.

2. Biological Studies by Species

a) Haddock and Atlantic cod

Northeast Fisheries Center scientists showed through laboratory experimentation that the growth of haddock and Atlantic cod larvae depends on temperature.

b) Atlantic herring

A total of 16,993 Atlantic herring, 1,796 adults and 15,197 juveniles, was tagged along the Maine coast in Division 5Y in 1977 by the Maine Department of Marine Resources to determine if these fish remain in local waters or more seasonally to other areas. The juvenile herring seem to move only short distances since 95% of their tag returns were within 25 mi of the tagging site. Many adult tags were returned from the winter fishery in Massachusetts Bay. Age and growth studies of Atlantic herring, caught along coastal Maine, in Massachusetts Bay (Division 5Y), and on Georges Bank (Subdivision 5Ze) were initiated in 1977 under a contract with the National Marine Fisheries Service. Samples were processed for length, weight, sex, and stage of maturity. Otoliths were collected for aging and racial work.

c) Sharks, tunas, and billfishes

The Northeast Fisheries Center continued its tagging study of sharks, tunas, and billfishes in the Atlantic Ocean, Gulf of Mexico, and Mediterranean Sea, with an emphasis on the migrations, feeding, growth, and reproduction of sharks. Northeast Fisheries Center scientists sent such information on sharks to those fishermen who helped by tagging 3,000 fish and recapturing 100 others that had been tagged before.

d) Alewives

Biological sampling of commercially fished stocks of alewives along the Maine coast (Division 5Y) was continued in 1977 by the Maine Department of Marine Resources. Data collected included sex ratios, catch, age composition of the stocks, spawning stock size, escapement, and production of offspring.

e) Rainbow smelt

A creel survey of the winter recreational fishery for rainbow smelt continued by the Maine Department of Marine Resources on the Kennebec River estuary (Division 5Y) using a stratified random design. Catch and effort statistics were collected. A total of 2,365 smelt was tagged at three locations in the Kennebec River estuary. Eleven tags (0.46%) were recovered, indicating a very low exploitation rate for this fishery.

f) Atlantic and shortnose sturgeons

Atlantic and shortnose sturgeon research by the Maine Department of Marine Resources in the Kennebec-Sheepscot River estuary (Division 5Y) continued. The purpose of this program is to assess the abundance and distribution of sturgeon in this estuary system. During 1977, 246 shortnose and eight Atlantic sturgeon were tagged.

g) Northern shrimp (*Pandalus borealis*)

Laboratory experiments by the Maine Department of Marine Resources were conducted to determine the relation between water temperature and the recruitment success of northern shrimp (*Pandalus borealis*) through its effect on egg survival and hatching time. Results indicate that unusually warm winters may accelerate the development rate of the eggs so that hatching takes place before food organisms appear in the water.

3. Gear and Selectivity Studies, including studies of fishing operations

Engineers at the Northeast Fisheries Center developed a small beam trawl for use by scientists and commercial fishermen, experimented with squid pair trawling, developed hardware for calibrating hydroacoustical fisheries assessment equipment, and improved surf clam and quahog assessment equipment. Diver-scientists evaluated the effectiveness and efficiency of the hydroacoustics and shellfish assessment methods.

The Massachusetts Division of Marine Fisheries assesssed an apparent gear conflict problem between mobile and fixed gear. This work is being conducted through the use of aerial overflights and onboard observers. The work is performed in Subdivision 5Zw and Division 5Y.

In 1977, the Massachusetts Division of Marine Fisheries also concluded a 1-yr study to evaluate the effect of a lobster escape vent on the catch of lobsters in various Massachusetts ports (Division 5Y and Subdivision 5Zw).

The Maine Department of Marine Resources completed a study of escape vents which allow the escapement of small lobsters yet retain *Cancer* sp. crabs with a carapace of 90 mm or larger.

During the past year in Division 5Z, the Rhode Island Division of Fish and Wildlife completed a study to assess the effect on lobster escapement and by-catch resulting from the installation of escape vents in lobster traps, and a program to acquire information on the lobster fishery through initiation of a logbook reporting system. Data being collected for the latter program include effort (by area), catch per unit of effort (trap haul setover days), and landings.

4. Miscellaneous Studies

The semiannual research vessel surveys by the Northeast Fisheries Center were continued in 1977. Tables 3-19 present information derived from these surveys. To improve the surveys, Northeast Fisheries Center scientists worked on a sonar system that records the species, sizes, and numbers of fishes located above the fishing depth of a bottom trawl, and studied the performance of mid-water and bottom trawls. Diver-scientists were a vital part of the hydroacoustical study.

The Northeast Fisheries Center also participated in surveys aboard research vessels from Canada, West Germany, East Germany, Japan, Poland, and the Soviet Union. Investigations aboard these ships focused on Atlantic herring, squids, sea scallops, and associated mid-water and bottom-dwelling species. Two special projects were the second year of international efforts to tag Atlantic herring in the Gulf of Maine - Georges Bank area in order to study movements, and the study of the effects of the Argo Merchant oil spill from the Polish R/V Wieczno (Subdivision 5Ze).

Another approach to gather information on fisheries resources was the underwater study by the Northeast Fisheries Center of the Atlantis Submarine Canyon (Subdivision 5Zw) fishes with the deep submergence R/V Alvin, and of Gulf of Maine (Division 5Y) Atlantic herring spawning grounds with SCUBA gear.

Also in 1977, the Massachusetts Division of Marine Fisheries concluded a 5-yr program of fishery stock assessment in Nantucket Sound. Basically, this program was assessing spring-fall groundfish populations utilizing standard National Marine Fisheries Service techniques for adult stock assessment. The work was performed in Subdivision 5Zw.

Additional research at the Northeast Fisheries Center has concentrated on the effects of natural environmental influences on the growth and mortality of subadult fishes in the Gulf of Maine and Georges Bank. Scientists have also measured not only the growth but also the health of early life stages of fishes by looking at the ratio of ribonucleic acid to deoxyribonucleic acid in embryonic cells, and they have also assessed the health of embryonic fishes by noting abnormalities in the chromosomes and divisions of various cells.

The Atlantic Environmental Group has looked into the role of climate on fisheries production. Ongoing research includes the influence of climate on groundfishes in the southern New England area (Subdivision 5Zw).

Scientists at the Northeast Fisheries Center have studied the nature and extent of diseases in marine mollusks, crustaceans, and fishes. Over 4,000 mollusks (many prior to introduction into American waters) were examined for parasites and diseases. Research also continued on the role of viruses in neoplasia in mollusks. Work with fishes indicated that a newly discovered bacterium was the cause of certain lesions on summer flounder.

Also, on Georges Bank (Subarea 5Ze), Northeast Fisheries Center scientists are determining the amount and rate of flow of energy through the ecosystem. Stomachs from 30,000 fish have been analyzed to determine the food web in that area.

The pathology project of the Maine Department of Marine Resources collected and analyzed samples of blood from marine anadromous and freshwater finfish in Subarea 5 to determine the incidence and distribution of P.E.N., a viral blood infection. The virus was found in 14 commercially important marine species.

III. STATISTICAL AREA 6

A. Status of the Fisheries

1. Silver Hake

Landings for food purposes climbed to their highest levels in more than a decade (Table 20). Industrial landings also increased, although not as significantly as food landings (Table 20).

Table 20. US silver hake statistics, Statistical Area 6 (MT, round fresh).

Year	Food landings	Industrial landings
1966	3,277	-
1967	4,416	-
1968	3,401	-
1969	2,793	372
1970	2,134	114
1971	2,749	240
1972	228	48
1973	4,091	99
1974	4,455	91
1975	4,518	208
1976	4,860	229
1977	6,148	277

2. Atlantic Herring

The US Atlantic herring fishery plummeted 75% from the 1976 levels, contributing to the generally downward trend since good statistics were first produced in 1973 (Table 21). The US spring research vessel survey abundance index for 1977 also decreased and remained well below the long-term average (Table 21).

Table 21. US Atlantic herring statistics, Statistical Area 6.

Year	Landings (MT, round fresh)	Survey index[a]
1968	-	17.4
1969	-	6.4
1970	-	1.2
1971	-	3.7
1972	-	2.6
1973	529	5.6
1974	278	1.3
1975	488	<0.1
1976	187	0.5
1977	46	0.1

[a]Stratified mean catch per survey tow in numbers.

3. Atlantic Mackerel

Landings of Atlantic mackerel decreased by 47% from the preceding year, 1976 (Table 22). However, the landings per standardized day fished remained basically the same as in 1975 and 1976 (Table 22). The US spring and autumn research vessel survey abundance indices dropped to new lows with the exception of the 1969 and 1975 values, respectively (Table 17 incorporates the indices for Statistical Area 6 with those for Subarea 5).

Table 22. US Atlantic mackerel statistics, Statistical Area 6 (MT, round fresh).

Year	Landings	Landings/standard day fished[a]
1964	380	0.4
1965	531	0.5
1966	821	0.8
1967	675	1.8
1968	928	2.8
1969	491	1.9
1970	957	2.1
1971	813	1.3
1972	981	0.8
1973	715	0.5
1974	567	0.2
1975	1,113	0.5
1976	1,302	0.6
1977	682	0.5

[a]Subarea 5 values also included.

4. Sea Scallops

Landings increased to their highest levels since 1966 (Table 23). Effort also increased significantly, but not as much proportionately. Thus, the catch per unit of effort, or the landings per day fished, reached an all-time high since such statistics were first kept (1970) (Table 23).

Table 23. US sea scallop statistics, Statistical Area 6 (MT, meats).

Year	Landings	Days fished	Landings/ day fished
1966	6,245	-	-
1967	3,332	-	-
1968	4,312	-	-
1969	1,895	-	-
1970	1,059	2,118	0.5
1971	895	2,237	0.4
1972	1,306	2,612	0.5
1973	857	1,714	0.5
1974	1,568	1,961	0.8
1975	2,706	3,006	0.9
1976	3,288	2,726	1.2
1977	5,780	4,445	1.3

B. <u>Special Research Studies</u>

1. Environmental Studies

a) Hydrographic studies

Cruises were made by the New Jersey Department of Environmental Protection to 12 mi offshore to monitor the formation of the thermocline and subsequent oxygen reduction in Division 6A. Oxygen and nutrient data were also collected at sea and inlets were sampled for dissolved and particulate carbon contributions.

b) Plankton studies

At the Northeast Fisheries Center, scientists studied the relative abundance of larval fishes to detect any future changes in the adult populations. This approach has been successful with the Atlantic croaker where the number of larvae in 1974 was 90% greater than in 1973; and those 1974 larvae entered the fishery off Virginia, Maryland, and New Jersey (Divisions 6A and 6B) last year where catches increased from 220 MT the previous year to 3,500 MT last year. In the Mid-Atlantic Bight (Statistical Area 6) there was the fourth straight year of large catches of sand lance. Sand lance are important forage for major commercial and recreational fishes, but as larvae they might also be severely outcompeting for food the larvae of those same commercial and recreational fishes.

c) Benthic studies

Data on lobster (Homarus americanus) harvest along the New Jersey coast (Division 6A) was gathered and analyzed and lobsters were tagged by the New Jersey Department of Environmental Protection.

The Virginia Institute of Marine Science obtained catch and effort data from the American lobster (Homarus americanus) fishery and described some of the biological characteristics of the lobster stocks on the continental shelf and in canyons at the edge of the shelf off Virginia (Divisions 6B and 6C).

The Virginia Institute of Marine Science studied the glycogen metabolism of the American oyster (Crassostrea virginica). It has long been known from the seasonal variation in glycogen content that carbohydrates are of prime metabolic importance in the oyster. However, little has been done to characterize the free sugars of the hemolymph. This study examined which carbohydrates are present and attempted to determine which one is the animal's "blood sugar". This information would aid future nutritional and physiological studies of this commercially valuable mollusk.

d) Other environmental studies

The Northeast Fisheries Center continued its study of environmental conditions in the New York Bight (Division 6A). Baseline information was developed on the distribution of organic contaminants and heavy metals in the Bight. It was also found that such highly stressed environments as the Bight can increase the numbers of phytoplankton produced as well as changing the species of phytoplankton. The results of this latter finding also suggest that much of the primary food production in stressed environments is in a dissolved organic state which is generally unavailable to the rest of the food web.

Northeast Fisheries Center scientists studied the impact of low dissolved oxygen levels in the Mid-Atlantic Bight (Statistical Area 6) on surf clams and important forage fish species. The causes of the low dissolved oxygen, which occurred in 1976 as well as in 1977, were also studied.

The Atlantic Environmental Group participated in studies of the impact of man-induced changes in the fishery environments in the vicinity of Deepwater Dumpsite 106 off New Jersey (Division 6A).

The Maryland Department of Natural Resources evaluated the biological and economic impacts of the contamination of surf clam and ocean quahog stocks in the Philadelphia Dumpsite area (Division 6B).

2. Biological Studies by Species

a) Atlantic mackerel

The Northeast Fisheries Center also conducted a study of Atlantic mackerel reproduction in the Mid-Atlantic Bight (Statistical Area 6).

b) Urophycis sp.

A compilation of accounts of all species of Urophycis is underway by the Virginia Institute of Marine Science for inclusion in Fishes of the Western North Atlantic. This effort is approximately 75% complete.

c) Sandbar shark

The Virginia Institute of Marine Science continued studies begun in 1973 of the seasonal patterns of distribution, abundance, and species composition of sharks off Virginia (Divisions 6B and 6C). Life history data are being collected for dominant species. A paper entitled, "The Biology of the Sandbar Shark," was derived from the project.

d) Gonostoma elongatum

A histological study by the Virginia Institute of Marine Science of a western Atlantic deepsea fish (Gonostoma elongatum) is in progress to determine the mode of reproduction. Preliminary analysis of gonads indicates that the species is hermaphroditic. A North Pacific species (Gonostoma gracile) is a protandrous hermaphrodite in which all or most individuals reverse sex from male to female.

3. Gear and Selectivity Studies, including studies of fishing operations

The Virginia Institute of Marine Science is evaluating and describing the biological and physical features of aquatic ecosystems which affect the obtaining of accurate samples of fish eggs and larvae, listing the types of gear used and assessing their accuracy in obtaining samples of fish eggs and larvae in relation to power generation facilities, and compiling a list of factors to be maximized in sampling gear. An ichthyoplankton gear and sampling handbook is being prepared for use by resource management personnel, program administrators, and researchers.

4. Miscellaneous Studies

The semiannual research vessel surveys by the Northeast Fisheries Center were continued in 1977. Tables 20-23 present information derived from these surveys.

The Northeast Fisheries Center continued censusing the recreational charter and party boat fishery off Maryland, New Jersey, and New York (Divisions 6A and 6B). Information on catches, the amount of effort expended, and the lengths, weights, and ages of the fishes landed was used in the preparation of stock assessments.

The Atlantic Environmental Group has looked into the role of climate on fisheries production. Ongoing research includes the influence of climate on sharks in the Long Island area (Division 6A) and blue crabs in the Delmarva area (Division 6B).

Scientists at the Northeast Fisheries Center have studied the nature and extent of diseases in marine mollusks, crustaceans, and fishes. Over 4,000 mollusks were examined for parasites and diseases. Research also continued on the role of viruses in neoplasia in mollusks. Studies with crustaceans included detailed observations on the types of, and changes in, normal tissues and organs of the blue crab, and electron microscopy of fouling organisms (bacteria, diatoms, protozoa) involved in the black gill disease of New York Bight (Division 6A) rock crabs. Work with fishes indicated that a newly discovered bacterium was the cause of certain lesions on summer flounder, and that an as yet unidentified gram-negative bacterium caused a large die-off of striped bass in western Long Island Sound (Division 6A) during the autumn.

The Northeast Fisheries Center looked into the possible roles and effects of pollutants as causes of diseases in marine organisms. Studies have shown no correlation between fin rot disease in fish and dumping of sewage sludge in New York Bight (Division 6A). Other studies have dealt with the effects of chlorinated hydrocarbons, cadmium, and copper on marine organisms.

The Virginia Institute of Marine Science reexamined three alternative schemes for managing the surf clam fishery in the light of the Fishery Conservation and Management Act of 1976 and recent changes in the fishery. All three schemes would limit entry in the fishery and would assign property rights to the resource. Two of the schemes focus on limitation of effort while the other focuses directly on the resource through assignment of catch rights.

Laboratory work on fish stomachs content analysis was completed and data analysis was begun in a marine food chain study by the New Jersey Department of Environmental Protection.

The Virginia Institute of Marine Science is in the midst of a major study of the Norfolk Canyon and adjacent continental slope (Division 6B). This study includes projects on: (1) the distribution and abundance of mesopelagic fishes based on bottom trawl surveys during 1972-1975; (2) ecology, particularly species diversity and ecology, of demersal fishes collected during seasonal bottom trawl surveys based on a stratified random design; (3) histology of modes of reproduction in dominant species of demersal fish communities; (4) the life history, host specificity, and site specificity of parasites of dominant species of demersal slope fishes; (5) the biology of noncommercial crustaceans in the canyon between 200 and 2,000-m isobaths, with emphasis on bathymetric distribution, reproductive biology, and feeding habits of major species, and on comparison with nearby, open-slope, crustacean communities; (6) biology of commercially important decapod crustaceans (American lobster, Homarus americanus, red crab, Geryon quinquedens, Jonah crab, Cancer borealis, and rock crab, C. irroratus) focusing on species composition and spatial distribution of decapod communities in the Canyon as compared with those communities from a nearby open-slope area and from the contiguous continental shelf adjacent to Chesapeake Bay, on biological aspects such as reproduction and intermolt cycle of selected dominant species in order to recognize seasonal patterns, on biological data from subdominant and/or rare species, and on relationships between biological data and environmental parameters; (7) size at sexual maturity, abundance, and distribution of the Jonah crab; and (8) quantitative and qualitative descriptions of zooplankton communities, particularly with respect to season and depth.

The Virginia Institute of Marine Science is conducting a benchmark study of the outer continental shelf in the Mid-Atlantic Bight area (Statistical Area 6). This study includes projects on: (1) describing (using ICNAF, National Marine Fisheries Service, and their own data) the community structure and related parameters for finfishes; (2) describing (using data gathered during ongoing cruises supported by the Bureau of Land Management) the community structure and related parameters of finfishes specifically in the Baltimore Canyon Trough area (Division 6B); (3) food habits and food selectivity and competition among the dominant species of demersal fishes found off New Jersey (Division 6A) via seasonal sampling of the benthos and fishes for stomach analysis; (4) developing techniques for handling and rearing deepwater decapod larvae on shipboard and in the laboratory as a basis for describing those larvae, as well as their distribution as determined by zooplankton and neuston tows and their relationship to the adult (benthic) community and to environmental parameters; (5) identifying the species of hyperiid (pelagic) amphipods found off southern New Jersey (Division 6A), estimating seasonal and inshore-offshore relative abundance of the identified species, and preparing keys for identification; (6) neuston and zooplankton collections for identification, hydrocarbon and trace metal analyses, and analysis of tarballs; and (7) identification and quantification of hydrocarbons and trace metals from water (only the former), suspended particulates, sediment, and organisms, as well as analyzing and developing methods for analyzing total sediment nitrogen.