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National Marine Fisheries Service
Northeast Fisheries Center
Woods Hole, Massachusetts 02543

The United States landed fish from ICNAF Subareas 4 and 5 and Statistical Area 6. Research was conducted in Subareas 3, 4, and 5, and Statistical Area 6. Table 1 gives a summary of US finfish and sea scallop nominal catches for 1975 and 1976.

Table 1. United States finfish and sea scallop nominal catches for 1975 and 1976 (MT, round fresh).

Species	Year	Subarea or Statistical Area			
		4	5	6	Total
Haddock	1975	2,162	5,166	-	7,328
	1976	1,018	4,731	2	5,751
Atlantic cod	1975	497	23,916	418	24,831
	1976	346	24,099	285	24,730
Redfish	1975	5,464	9,075	1	14,540
	1976	4,446	10,127	-	14,573
Pollock	1975	741	8,189	4	8,934
	1976	620	9,592	1	10,213
Yellowtail flounder	1975	63	20,138	532	20,733
	1976	12	16,916	220	17,148
Other flounder	1975	120	15,968	7,848	23,936
	1976	73	17,515	7,829	25,417
Silver hake	1975	7	16,151	4,726	20,884
	1976	1	17,502	5,089	22,592
Red hake	1975	3	1,760	724	2,487
	1976	3	2,643	1,840	4,486
Atlantic sea herring	1975	-	35,681	478	36,159
	1976	-	49,946	187	50,133
Atlantic mackerel	1975	-	547	1,113	1,660
	1976	-	1,044	1,302	2,346

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

Table 1. (cont'd)

Species	Year	Subarea or Statistical Area 4	5	6	Total
River herring[a]	1975	-	2,568	8,190	10,758
	1976	-	1,594	4,770	6,364
Menhaden	1975	-	26,465	167,926	194,391
	1976	-	39,414	231,544	270,958
Butterfish	1975	-	879	1,209	2,088
	1976	-	756	760	1,516
Other finfish	1975	839	14,770	28,761	44,370
	1976	157	12,012	34,966	47,135
Total finfish	1975	9,896	181,273	221,930	413,099
	1976	6,676	207,891	288,795	503,362
Sea scallop	1975	-	13,754	20,956	34,710
	1976	-	17,218	27,389	44,607

[a]Alewife and blueback herring.

Subarea 3

B. Special research studies

All special research studies are included in the Subarea 5 and Statistical Area 6 description.

Subarea 4

A. Status of the fisheries

1. Haddock

The US nominal catch of haddock from Subarea 4 declined in 1976 (Table 2). The research vessel survey index of young of the year also declined while the landings per day fished increased slightly.

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

Year	Division 4X Landings	Division 4X YOY survey index[a]	Browns Bank Landings	Browns Bank Days fished	Browns Bank Landings/day fished
1966	2,473	1.32	939	200	4.7
1967	5,014	1.10	2,059	381	5.4
1968	3,156	1.51	2,278	506	4.5
1969	1,830	3.31	1,305	389	3.4
1970	1,744	1.03	1,576	493	3.2
1971	751	6.08	605	242	2.5
1972	448	2.28	387	117	3.3
1973	269	1.83	268	107	2.5
1974	670	2.90	648	-[b]	-[b]
1975	2,142	4.52	2,098	477	4.4
1976	986	3.47	904	181	5.0

[a]Mean catch of young-of-the-year fish per haul (linear scale retransformed from $\log_{10}$ scale).
[b]Landings per day not calculated due to 10% trip limitation.

2. Atlantic cod

The US fleet landed 346 metric tons of Atlantic cod from Subarea 4 in 1976, 151 metric tons less than in 1975.

3. Redfish

There were no US landings of redfish from the Gulf of St. Lawrence (Divisions 4R, S, and T) (Table 3). Landings from the Scotian Shelf (Divisions 4V, W, and X) dropped although effort increased (Table 4). The catch per unit of effort and the research vessel survey index dropped sharply from the previous year.

Table 3. US redfish statistics, Divisions 4R, S, and T (MT, round fresh).

Year	Landings	Days fished	Landings/day fished
1966	12,766	608	21.0
1967	15,482	622	24.9
1968	16,437	740	22.2
1969	12,122	689	17.6
1970	7,592	593	12.8
1971	4,706	490	9.6
1972	1,111	104	10.7
1973	1,638	144	11.4
1974	1,031	104	9.9
1975	-	-	-
1976	-	-	-

Table 4. US redfish statistics, Divisions 4V, W, and X (MT, round fresh).

Year	Landings	Days fished	Landings/day fished	Survey wt/tow[a]
1966	16,680	1,183	14.1	20.2
1967	6,407	593	10.8	33.4
1968	4,635	297	15.8	15.3
1969	1,142	75	15.3	42.6
1970	1,949	135	14.2	50.4
1971	6,261	404	15.5	39.7
1972	12,365	840	14.7	25.7
1973	11,290	965	11.7	38.6
1974	8,897	780	11.4	16.1
1975	5,464	547	10.0	21.8
1976	4,446	645	6.9	12.4

[a]Weight in pounds.

B. Special research studies

All special research studies are included in the Subarea 5 and Statistical Area 6 description.

Subarea 5 and Statistical Area 6

A. Status of the fisheries

1. Haddock

Haddock landings from Subarea 5 in 1976 were again limited by quota regulations set by the Commission, and US vessels landed 4,731 tons (Table 5).

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

Year	Subarea 5 landings	Division 5Y landings	Subdivision 5Zw landings	Subdivision 5Ze	
				Landings	Adjusted landings/ standard day fished (MT, landed wt)
1966	57,497	4,579	31	52,887	5.27
1967	39,580	4,852	37	34,691	4.02
1968	28,887	3,418	16	25,453	3.11
1969	18,858	2,402	15	16,441	2.47
1970	9,872	1,457	15	8,400	1.82
1971	8,500	1,194	5	7,301	1.72
1972	4,771	901	3	3,867	1.77
1973	3,314	526	3	2,785	0.96
1974	3,034	628	2	2,404	-[a]
1975	5,166	1,180	17	3,969	-[b]
1976	4,731	1,834	2	2,895	-[b]

[a]Landings per day not calculated due to 10% trip limitation.
[b]Landings per day not calculated due to varying incidental haddock catch limitations.

The 0-age-group index for haddock declined in 1976 from the relatively high level in 1975 (Table 6).

Table 6. US research vessel index of relative year-class abundance of Georges Bank haddock based on autumn catches of 0-age-group fish.

Year	Index	Year	Index
1959	9.6	1968	1.0
1960	2.4	1969	1.1
1961	1.4	1970	1.0
1962	2.6	1971	1.4
1963	12.6	1972	2.0
1964	2.0	1973	1.8
1965	1.2	1974	1.3
1966	1.7	1975	3.8
1967	1.0	1976	1.7

2. Atlantic cod

US landings of Atlantic cod from Subarea 5 in 1976 remained approximately the same as in 1975 (Table 7). 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 have increased since 1968; however, this is probably a reflection of change in fishing practices (i.e., a greater directed fishery for Atlantic cod in the absence of haddock). The research survey index again showed an increase.

Table 7. US Atlantic cod statistics, Subarea 5 (MT, round fresh).

Year	Subarea 5 landings	Division 5Y landings	Subdivision 5Zw landings	Subdivision 5Ze		
				Landings	Landings/ day fished	Survey wt/tow[a]
1966	15,343	4,008	345	10,990	1.1	11.1
1967	18,057	5,527	684	11,846	1.0	18.5
1968	21,045	6,360	836	13,849	1.4	11.7
1969	24,175	7,823	1,143	15,209	1.6	10.9
1970	22,347	7,812	1,182	13,353	2.1	17.1
1971	23,175	7,380	796	14,999	2.0	13.4
1972	19,704	6,564	662	12,478	2.6	31.3
1973	22,001	6,063	1,092	14,846	4.2	42.0
1974	25,290	7,426	1,220	16,645	3.9	11.2
1975	23,915	8,676	644	14,594	3.8	19.1
1976	24,099	9,879	280	13,940	3.9	24.0

[a]Weight in pounds.

3. Silver hake

Total US silver hake landings from Subarea 5 and Statistical Area 6 in 1976 increased slightly from 21,000 metric tons in 1975 to 22,000 metric tons (Table 1). Landings-per-day-fished indices (Table 8) in Division 5Y and Subdivision 5Ze showed a sharp increase over the previous year. In Division 5Y landings and effort data of class 2 vessels (0-50 tons) indicate increased abundance after a continual decline since 1966. Catch per unit of effort indices for Subdivision 5Ze, from landings and days fished data of class 3 vessels (51-150 tons), also increased from 15.0 in 1974 to 22.7 in 1975 to 46.1 in 1976. Commercial abundance indices obtained from landings and days fished data of class 2 vessels fishing in depths less than 56 meters in Subdivision 5Zw and Division 6A increased slightly from 5.7 in 1975 to 6.6 in 1976.

US silver hake abundance indices from autumn survey cruise data (Table 9) increased in all areas in 1975 and 1976 after a decrease in 1974, indicating the possibility of stock recovery in the future. Spring indices showed relatively little change.

Table 8. US silver hake statistics, Subarea 5 and Statistical Area 6 (MT, round fresh).

	Division 5Y		Subdivision 5Ze		Subdivision 5Zw and Statistical Area 6				
					Food landings			Industrial landings	
Year	Landings	Landings/ day fished	Landings	Landings/ day fished	5Zw	6	Landings/ day fished	5Zw	6
1966	21,323	18.2	16,222	26.1	3,281	3,277	4.6	-	-
1967	14,390	17.1	12,692	31.8	607	4,416	5.2	3,297	-
1968	24,706	17.8	6,451	25.3	1,221	3,401	5.3	3,541	-
1969	14,609	10.1	1,654	13.3	1,429	2,793	6.2	2,809	372
1970	11,384	7.7	4,238	23.8	2,441	2,134	7.7	1,218	114
1971	8,263	8.6	3,169	17.4	1,069	2,749	4.9	923	240
1972	5,548	7.1	979	8.7	1,499	228	6.2	117	48
1973	8,348	9.9	5,704	22.6	1,129	4,091	4.8	795	99
1974	4,634	6.3	2,285	15.0	1,946	4,455	4.3	669	91
1975	8,042	7.8	4,588	22.7	1,999	4,518	5.7	1,522	208
1976	9,746	16.7	3,793	46.1	2,747	4,860	6.6	1,216	229

Table 9. Silver hake abundance indices (mean weight in pounds/tow) from US survey cruises.

Year	Division 5Y (Gulf of Maine)		Subdivision 5Ze (Georges Bank)		Subdivision 5Zw and Division 6 (Southern New England)	
	Spring	Fall	Spring	Fall	Spring	Fall
1963	-	58.3	-	7.9	-	11.5
1964	-	10.3	-	2.8	-	12.5
1965	-	17.4	-	3.3	-	16.8
1966	-	9.4	-	3.3	-	7.9
1967	-	5.3	-	2.3	-	9.8
1968	0.1	4.2	0.8	5.5	16.2	10.5
1969	0.4	5.4	1.2	3.7	8.4	5.1
1970	0.7	6.6	1.6	2.8	3.7	5.7
1971	0.8	6.1	1.7	2.7	8.2	10.1
1972	3.8	14.3	1.1	3.0	5.1	8.8
1973	1.6[a]	9.2	1.8[a]	3.8	2.6[a]	7.1
1974	1.6[a]	8.3	0.7[a]	2.4	3.7[a]	2.7
1975	5.3[a]	20.1	0.9[a]	4.4	6.8[a]	6.1
1976	5.1[a]	23.8	0.9[a]	9.8	4.3[a]	8.6

[a]These spring cruises were made with the Yankee #41 trawl so these values have been adjusted to the normal #36 trawl.

4. Redfish

US landings of redfish from Subarea 5 increased slightly in 1976. The landings-per-day index remains at a relatively low level (Table 10).

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

Year	Subarea 5 landings	Division 5Y (Gulf of Maine)		
		Landings	Days fished	Landings/day fished
1966	7,204	4,719	429	11.0
1967	10,442	6,746	649	10.4
1968	6,576	4,060	292	13.9
1969	12,038	9,637	824	11.7
1970	15,534	13,551	1,473	9.2
1971	16,267	12,541	1,695	7.4
1972	13,161	7,150	1,132	6.3
1973	11,922	7,008	1,168	6.0
1974	8,690	5,464	1,012	5.4
1975	9,075	5,961	1,362	4.4
1976	10,127	7,985	1,705	4.7

The redfish stock abundance indices for the Gulf of Maine and Georges Bank declined sharply in 1976 (Table 11).

Table 11. Redfish abundance indices from US autumn survey cruises.

Year	Division 5Y (Gulf of Maine)		Subdivision 5Ze (Georges Bank)	
	Wt/tow[a]	No/tow	Wt/tow[a]	No/tow
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

[a]Weight in pounds.

5. Yellowtail flounder

The US total catch of yellowtail flounder (including discards) from Subarea 5 in 1976 was about 2,000 metric tons (Table 12) below that of 1975. Yellowtail flounder landings for food took most of this loss while landings of those for industrial purposes were negligible.

The southern New England abundance indices show some signs of improvement, while the Georges Bank index continued to decline (Table 13).

Table 12. US yellowtail flounder statistics, Subarea 5 (MT, round fresh).

Year	Food landings	Landings/ day fished	Estimated discards	Estimated industrial landings	Total catch
1966	28,656	2.0	8,253	2,364	39,273
1967	20,819	2.2	14,407	4,587	39,813
1968	28,645	3.0	10,627	3,939	43,211
1969	28,739	2.7	5,202	4,265	38,206
1970	29,825	2.5	10,689	2,095	42,608
1971	21,700	2.1	7,124	397	29,221
1972	23,886	2.1	3,100	327	27,313
1973	24,710	2.2	1,086	343	26,139
1974	23,145	1.8	993	22	24,160
1975	18,857	1.5	1,246	35	20,138
1976	16,538	1.5	951	15	17,504

Table 13. Yellowtail flounder abundance indices from US survey cruises.

	Southern New England (W of 69°)		Georges Bank (E of 69°)	
Year	Wt/tow[a]	No/tow	Wt/tow[a]	No/tow
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

[a]Weight in pounds.

6. Red hake

Red hake landings by US vessels from Subarea 5 in 1976 increased slightly (Table 14). The 1976 autumn research vessel survey cruise indicated relatively little change in stock abundance for all three subdivisions (Table 15).

Table 14. US red hake statistics, Subarea 5 (MT, round fresh).

		Food fish		Industrial fish	
Year	Subarea 5 landings	Division 5Y landings	Subdivision 5Ze landings	Subdivision 5Zw landings	Landings/ day fished
1966	4,280	634	845	2,801	2.3
1967	5,759	92	169	5,498	5.6
1968	6,216	82	161	5,973	7.0
1969	4,923	140	225	4,558	8.2
1970	4,281	249	100	3,932	6.3
1971	2,783	268	111	2,404	8.4
1972	1,711	373	160	1,178	-
1973	2,940	286	77	2,577	-
1974	1,887	407	81	1,399	-
1975	1,760	394	55	1,310	-
1976	2,227	618	37	1,572	-

Table 15. Red hake abundance indices (mean weight in pounds/tow) from US autumn survey cruises.

Year	Division 5Y (Gulf of Maine)		Subdivision 5Ze (Georges Bank)		Subdivision 5Zw (Southern New England)	
	Spring	Fall	Spring	Fall	Spring	Fall
1963	-	10.9	-	17.3	-	17.8
1964	-	1.5	-	5.8	-	9.6
1965	-	22.0	-	4.6	-	12.4
1966	-	1.6	-	33.1	-	6.4
1967	-	0.9	-	1.6	-	5.9
1968	2.0	0.3	0.6	3.0	4.3	9.7
1969	1.0	0.0	0.9	4.0	3.6	10.6
1970	0.9	0.3	1.9	2.2	5.3	8.6
1971	1.2	2.2	3.4	4.5	11.9	7.4
1972	2.9	4.1	2.4	2.6	12.2	14.6
1973	2.6[a]	1.3	1.3[a]	6.7	4.7[a]	6.7
1974	1.5[a]	1.1	0.5[a]	3.4	3.5[a]	1.2
1975	2.6[a]	2.2	0.9[a]	16.8	3.2[a]	9.6
1976	2.1[a]	2.4	1.0[a]	9.7	7.8[a]	7.5

[a]These values were obtained from spring cruises using a #41 Yankee trawl and were adjusted to the #36 Yankee trawl.

7. Atlantic herring

The US Atlantic herring catch from Subarea 5 increased tremendously, while that from Statistical Area 6 continued to decline (Table 16). The US research vessel abundance indices remain extremely low (Table 17).

Table 16. US Atlantic herring landings from Subarea 5 (MT, round fresh).

Year	Subarea 5	Division 5Y	Subdivision 5Ze	Subdivision 5Zw	Statistical Area 6
1966	30,589	29,365	1,224[a]	-	-
1967	31,778	31,158	620[a]	-	-
1968	42,083	41,476	9	598	-
1969	30,780	28,687	832	1,261	-
1970	30,484	29,181	272	1,031	-
1971	33,890	31,491	1,194	1,205	-
1972	40,473	38,211	11	2,251	-
1973	25,675	21,601	162	3,912	529
1974	32,392	29,356	171	2,866	278
1975	35,681	31,591	3	4,088	488
1976	49,946	49,398	507	40	187

[a]Division 5Z.

Table 17. US research cruise indices of Atlantic herring abundance (mean number/tow).

Year	Autumn cruises, Georges Bank	Spring cruises, Southern New England	Spring cruises Mid-Atlantic
1963	7.02	-	-
1964	1.13	-	-
1965	6.45	-	-
1966	10.41	-	-
1967	3.26	-	-
1968	1.36	120.6	17.4
1969	1.14	45.8	6.4
1970	0.66	34.7	1.2
1971	0.55	4.1	3.7
1972	1.06	5.7	2.6
1973	0.12	7.2	5.6
1974	0.12	2.1	1.3
1975	0.02	0.1	0.02
1976	0.03	0.2	0.5

8. Atlantic mackerel

US Atlantic mackerel landings in Subarea 5 and Statistical Area 6 increased once again in 1975, with the greatest increase occurring in Subarea 5 (Table 18). US commercial landings per standardized day fished for the entire stock (Subarea 5 and Statistical Area 6) increased in 1976 to 0.59 metric tons per day, after a six-year decline to 0.17 in 1974. Abundance indices from US survey cruises in 1976 show slight increases in both the spring and fall (Table 19).

Table 18. US Atlantic mackerel statistics, Subarea 5 and Statistical Area 6 (MT, round fresh).

Year	Subarea 5 landings	Statistical Area 6 landings	SA 5&6 landings	Landings/standard US day fished in SA 5&6
1964	1,264	380	1,644	0.43
1965	1,467	531	1,998	0.49
1966	1,903	821	2,724	0.84
1967	3,216	675	3,891	1.75
1968	3,001	928	3,929	2.80
1969	3,873	491	4,364	1.92
1970	3,092	957	4,049	2.07
1971	1,593	813	2,406	1.29
1972	1,025	981	2,006	0.84
1973	621	715	1,336	0.53
1974	475	567	1,042	0.17
1975	547	1,113	1,660	0.53
1976	1,044	1,302	2,346	0.59

Table 19. Atlantic mackerel abundance indices[a] ($\log_e$ mean catch/tow in pounds) from US survey cruises.

Year	Spring	Fall
1965	-	0.07
1966	-	0.09
1967	-	0.32
1968	0.73	0.17
1969	0.03	0.21
1970	0.56	0.11
1971	0.52	0.09
1972	0.42	0.11
1973	0.25	0.06
1974	0.31	0.06
1975	0.11	0.02
1976	0.22	0.05

[a]Stratified: spring strata 1-14, 61-76; fall strata 1, 2, 5, 6, 9, 10, 13, 16, 19-21, 23, 25, 26.

9. Industrial groundfish fishery

New England landings for industrial purposes from Subarea 5 (predominantly Subdivision 5Zw) decreased in 1976 (Table 20).

Table 20. New England groundfish landings from Subarea 5 for industrial purposes (MT, round fresh).

Year	Total landings	Species composition (%) for Subdivision 5Zw				
		Silver hake	Red hake	Flounder	Eelpout	Other
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

10. Sea scallops

US sea scallop landings reached their highest level since 1968 (Table 21). Effort in 1976 decreased in both areas, although more vessels were fishing for sea scallops. The indicated increase in abundance appears to be largely due to the recruitment of a strong year class.

Table 21. US New England and Mid-Atlantic sea scallop statistics (MT of meats).

Year	Subarea 5			Statistical Area 6		
	Landings	Days fished	Landings/ day fished	Landings	Days fished	Landings/ days fished
1966	994	1,104	0.9	6,245	-	-
1967	1,309	1,870	0.7	3,332	-	-
1968	1,163	1,938	0.6	4,312	-	-
1969	1,991	3,980	0.5	1,895	-	-
1970	1,553	2,588	0.6	1,059	2,118	0.5
1971	1,697	3,394	0.5	895	2,237	0.4
1972	1,347	2,694	0.5	1,306	2,612	0.5
1973	1,543	2,572	0.6	857	1,714	0.5
1974	1,153	1,647	0.7	1,568	1,961	0.8
1975	1,650	2,062	0.8	2,706	3,006	0.9
1976	2,061	1,825	1.1	3,288	2,726	1.2

B. Special research studies[a]

1. Environmental studies

a. Hydrographic studies

The National Marine Fisheries Service (NMFS) conducted hydrographic research through six major efforts. First was a sampling of continental shelf waters from Nova Scotia to North Carolina for temperature, salinity, dissolved oxygen, and dissolved nutrients. These studies were performed in conjunction with various groundfish and larval fish surveys. Second was the beginning in September of a two-year program of direct current measurements in the Northeast Channel by placement inside the sill at about 66°W of three current-meter arrays, each with three current meters. Third and fourth were one survey of the deep Gulf of Maine and the continuation of the monthly temperature profiles and surface salinity samples in the gulf on board ships of opportunity between either Bar Harbor or Portland, Maine, and Yarmouth, Nova Scotia. A report of the first 18 months of this latter program has been submitted. Fifth, the US and other nations studied meanders and detached rings of the Gulf Stream that came in contact with the continental shelf or slope. Sixth were studies by NMFS, the University of Rhode Island (URI), and the Woods Hole Oceanographic Institution (WHOI), into the effects of the Argo Merchant oil spill.

[a]For all subareas and statistical areas.

The US Coast Guard (USCG) conducted four hydrographic cruises in Subarea 3 in the late spring and early summer including the deployment of two current meter arrays. Temperature profiles were taken by expendable bathythermographs (XBTs) in the late spring and early summer in Subareas 5 and 6. Hourly surface water samples, and XBT observations were taken on frequent cruises between Ambrose Light and Deepwater Dumpsite 106 in Division 6A. In August the USCG began a series of hydrographic casts, tarball tows, Secchi disc readings, and bathythermograph observations at Ocean Weather Station Hotel in Division 6B. In addition, six hydrographic sections were made of various locations between Newfoundland and Florida, and tarball tows were conducted during many of the offshore fisheries and law enforcement patrols.

The US Geological Survey (USGS) made seven cruises in the Georges Bank area to study water circulation and suspended matter.

The Environmental Research Laboratories'(ERL) Marine Ecosystems Analysis Program (MESA) sampled the New York Bight for temperature, salinity, conductivity, turbidity, pH, redox potential, dissolved oxygen, and dissolved nutrients. These parameters are being compared to water currents and water chemistry. Also worked on by MESA was an assessment of New York Bight circulation, tidal characteristics, and responses to weather. MESA was also involved in a modeling effort of the bight's circulation.

The National Ocean Survey (NOS) conducted studies of tidal currents and continental shelf water chemistry with the research vessels Ferrel and Researcher, respectively.

b. Plankton studies

In conjunction with the South Carolina Division of Marine Resources (SCMR), NMFS continued its Marine Monitoring, Assessment, and Prediction Program (MARMAP) zooplankton surveys from the Gulf of Maine to Cape Canaveral during the spring and fall with paired bongo samplers. Other NMFS plankton surveys occurred during the fall in the Mid-Atlantic Bight to monitor seasonal changes in abundance and distribution of plankton populations. In conjunction with the USCG, NMFS monitored plankton populations with two continuous plankton recorders in Divisions 5Z, 6A, and 6B. Neuston was also monitored in conjunction with the USCG at 28 locations in Divisions 5Z and 6A. NMFS laboratory research focused on: (1) estimating variations in zooplankton standing stocks in the Northwest Atlantic from 1971 through 1975; (2) determining changes in copepod population densities in relation to characteristics of Gulf of Maine coastal waters; (3) documenting the food of larval Atlantic herring in the Gulf of Maine; and (4) determining the length-weight relationships of the dominant zooplankters of Georges Bank. Special studies conducted on the impact of the Argo Merchant oil spill indicated that significant amounts of oil were ingested by copepods.

The MESA studies of the New York Bight continued in 1976. Work on the primary productivity of Raritan Bay was completed. Also completed for the Hudson/Raritan Estuary and the bight apex was work on: (1) changes in distribution and abundance of plankton in relation to selected environmental factors; (2) modeling of primary productivity; and (3) on the relationship between ocean dumping and estuarine runoff as they affect primary productivity. Studies continuing through 1976 were those on the plankton population dynamics and nutrient cycling in the inner bight and those on the effects of contaminants on plankton communities.

Investigations at WHOI emphasized the genetic variability of clones of diatom species isolated from neritic and oceanic waters using electrophoresis techniques and silicon uptake by diatoms in relation to light. Population succession and species behavior was examined in Gulf Stream cold-core rings. In addition, WHOI also investigated the species of copepods that produce resting eggs and the environmental factors that affect hatching.

Bigelow Laboratory research concentrated on the physiological ecology of phytoplankton with seasonal surveys at selected stations off the Maine coast and with more extensive surveys in the Gulf of Maine and on Georges Bank. The investigations concerned: (1) carbon assimilation during photosynthesis; (2) kinetics of nitrogen of assimilation; (3) use of enzymes to measure assimilation rates of essential nutrients; (4) use of the electron transport system to measure respiration; (5) flux of organic carbon compounds as revealed by measurements of excretion by phytoplankton and utilization by the microbial population; and (6) comparative biochemistry of dinoflagellates and diatoms with particular emphasis on the cause of red tides.

The Virginia Institute of Marine Science (VIMS) continued adding to its extended series of zooplankton collections from slope waters around Norfolk Canyon. The collections date back to 1973. A study was undertaken on the diel cycles and on the importance as food for commercially important species of neuston communities at six locations off southern New Jersey. The second year of plankton sampling for the Bureau of Land Management (BLM) began in November and expanded with two more stations south of Hudson Canyon and with four more along a transect from the eastern shore of Virginia to Norfolk Canyon.

The Duke University Marine Laboratory focused its research on the flux of carbon through planktonic communities. This research included: (1) assessments of temporal and spatial heterogeneity in estuarine and coastal phytoplankton species assemblages; (2) primary production and its regulation by secondary growth factors; (3) mechanisms by which continental shelf primary production is affected by intrusions of deep water onto the shelf; (4) feeding behavior of copepods; (5) copepod reproductive strategies; and (6) taxonomy and zoogeography of oceanic radiolaria.

Harvard University's Biological Laboratories continued research on nitrogenous nutrition of plankton in the southern Sargasso Sea and on physiological responses of phytoplankton to transient nitrogenous nutrient deprivation.

The State University of New York's (SUNY) Marine Sciences Research Center (MSRC) worked on: (1) the relationship between zooplankton ingestion rates and spatial heterogeneity in phytoplankton biomass distributions in Long Island Sound; (2) ability of particle-feeding zooplankton to increase feeding rates rapidly to take advantage of high food concentrations encountered in phytoplankton patches; (3) distribution of phytoplankton patches and their causes in Long Island Sound; and (4) changes in the size distribution, species composition, growth rates, and photosynthetic rates of phytoplankton communities being held in enclosures in tidal marshes on the north shore of Long Island. In a joint study with the Brookhaven National Laboratory, the MSRC worked on the types and concentrations of photosynthetic pigments and factors affecting their distribution on the southern New England continental shelf.

Johns Hopkins University's Chesapeake Bay Institute emphasized in 1976 both annual and short-term nutrient cycling in a major estuary.

Larval and juvenile fish

Both NMFS and SCDMR performed MARMAP-type sampling in the spring and fall from the Gulf of Maine to Cape Canaveral. Sand lance larvae predominated south of Cape Cod in the spring. Hake (Urophycis spp.) and Gulf Stream flounder larvae predominated in the Mid-Atlantic Bight, and silver hake and windowpane larvae predominated north of Cape Cod, in the fall. The NMFS also participated in a series of monthly ICNAF collections of larval Atlantic herring on Georges Bank from September through February. The 1976 production of larval Atlantic herring was the lowest observed since annual monitoring began in 1971. An analysis of the abundance, growth, and mortality of Georges Bank-Nantucket Shoals Atlantic herring larvae since 1973 showed an inverse relationship between mortality and growth which is believed to be regulated by food supply. It also appears that December through January may be the critical period for larval survival as it relates to year-class strength. In addition, a special study was conducted on the impact of the December spillage of oil from the Argo Merchant.

Key laboratory research by NMFS in 1976 focused on the mutagenic effects of environmental factors, including pollution, on fish eggs and larvae, and on the energetics of larval fish in relation to environmental factors. With respect to the latter area of research, work was done on the effects of temperature and food levels on such things as growth, metabolism, and survival for such larvae as summer flounder, yellowtail flounder, Atlantic herring, and Atlantic cod. An environmental-control chamber for in situ measurements of larval growth and survival was also developed and shipboard bioassays were undertaken on the feeding ability of newly hatched summer flounder and scup with the cooperation of the Brookhaven National Laboratory. In an additional study on the effects of oil on Atlantic cod embryos, it was found that 0.1-0.5 ppm of No. 6 oil caused significant mortalities. Work is also continuing on identifying fish larvae collected in earlier years of the Southeast Coast of the US, with a special emphasis on scombrids, istiophoids, and panulirids.

VIMS seasonally sampled six stations off southern New Jersey for ichthyoplankton as part of a survey of baseline conditions on the outer continental shelf.

c. Benthic studies

The main effort of NMFS in benthic studies in the Northwest Atlantic in 1976 was the production of a report on the macrobenthic fauna of the Mid-Atlantic Bight. The data related geographical area and bottom sediment types to the density of the various species studied. Work on benthic respiration by MESA in 1976 concentrated on decomposition rates of organic matter in surface and near-surface sediments, benthic respiration effects on water column oxygen content, and release/uptake of organic and inorganic chemical contaminants during oxidation of sedimentary organic material.

d. Trawl surveys

Spring and autumn bottom trawl surveys (Table 22) were conducted by NMFS with research vessels Albatross IV and Delaware II in continental shelf waters of 15-200 fathoms between Cape Hatteras and Nova Scotia. Inshore trawl surveys were completed between Cape Hatteras and Cape Cod as well as a winter trawl survey (inshore and offshore) and a spring surf clam survey. A two-year time series of monthly finfish trawl surveys in Sandy Hook-Raritan Bays continued. Special surveys conducted during the summer to assess the effect of a large anoxic water mass on the marine resources off the New Jersey coast indicated significant finfish distribution changes and surf clam mortality. Seven joint bottom trawl surveys were participated in with research vessels from FRG, France, GDR, Poland, and USSR to investigate Atlantic herring, Atlantic mackerel, squids, and groundfishes between Cape Hatteras and Nova Scotia. In December, a special survey was conducted to begin monitoring the effects of the Argo Merchant oil spill southeast of Nantucket Island.

e. Other environmental studies

NMFS continued studies on the impact of ocean dumping at several sites in the New York Bight, including the sewage sludge dredge spoil disposal area in the bight apex and at Deepwater Dumpsite 106 located in 2,000 meters of water off the shelf. Well defined changes in benthic community structure have been identified as associated with coastal dumping, and buildup of heavy metals has been noted in sediments and biota which are affected by point source of discharge and ocean dumping. No impact has been demonstrated to date as a result of off-the-shelf disposal of industrial wastes. NMFS personnel were involved in the investigation of a massive fish kill which occurred off the New Jersey coastline during the summer of 1976. The kill was attributed to oxygen depletion which resulted from a plankton bloom developing during a particularly warm summer and accompanied by well stratified water and little vertical mixing. NMFS physiologists continued their investigations of the effects of heavy metals and hydrocarbons on living marine resources. This experimental laboratory research suggests that relatively small amounts of metals can interfere with specific metabolic processes.

Table 22. Bottom offshore trawl survey cruises by NMFS in 1976.

Vessel	Cruise	Date	Season	No. of Stations	Area of Investigation	Trawl type	Speed (knots)
Anton Dohrn (FRG)	76-01	2 Mar- 9 Mar	Spring	41	Georges Bank	180-ft Herring	4.0
Ernst Haeckel (GDR)	76-01	3 Mar-16 Mar	Spring	43	Georges Bank to Gulf of Maine	490-ft Herring	3.5
Albatross IV & Delaware II	76-02,05	4 Mar- 8 May	Spring	300	Nova Scotia to Cape Hatteras	#41 Yankee	3.5
Albatross IV	76-02	18 Apr-24 Apr	Spring	44	Scotian Shelf	#41 Yankee	3.5
Wieczno (Poland)	76-01	6 May-29 May	Spring	99	Long Island to Georges Bank	90-ft Herring	3.5
Belogorsk (USSR)	76-01	6 Sep-21 Oct	Fall	111	New York Bight to Georges Bank	Hake 815	3.5
Albatross IV	76-09	20 Oct-23 Nov	Fall	267	Nova Scotia to Cape Hatteras	#36 Yankee	3.5
Cryos (France)	76-01	30 Oct- 5 Nov	Fall	23	Georges Bank	Lofoten	4.0
Cryos (France)	76-01	9 Nov- 3 Dec	Fall	83	Mid-Atlantic	Lofoten	4.0

Considerable effort by the MESA Project was devoted to studies of pollutant levels, sources, pathways, and sinks in the New York Bight. Among the investigations were: (1) a study of contaminant sources and input rates to the bight ecosystem; (2) the designation and ranking of the most serious chemical contaminants affecting the bight; (3) the identification and quantification of organic contaminants (hydrocarbons, fatty acids, alcohols, chlorinated hydrocarbons, and steriods) in bight sediments; (4) a study of metal concentrations in fish and shellfish; and (5) sludge tracking experiments investigating the short-term kinematics, dynamics, and chemical kinetics of dumped sewage sludge. In addition, the effects of contaminants on the fauna and flora of the bight were the subject of the following studies: (1) the possible relationship between bight degradation and fish and shellfish diseases (fin rot, exoskeletal erosion, and black gill disease); (2) a comparative study of fin rot disease in the New York Bight, southern California coastal waters; and the Duwamish Estuary (State of Washington), including an attempt to link the syndrome to various chemical contaminants; (3) an examination of the effects of common persistent chemical pollutants such as chlorinated hydrocarbons on natural and laboratory populations of phytoplankton and zooplankton; and (4) studies on the effects of metals on bacterial physiology (including heterotrophic potential and transfer resistance).

2. Biological studies by species

No report.

3. Gear and selectivity studies

NMFS completed a four-year program to develop a high-opening modified Yankee No. 41 bottom trawl for use as standard groundfish survey gear in waters of the Northwest Atlantic Ocean. Initial efforts were directed at the selection and testing of an appropriate rigging arrangement and the development of standardized handling procedures and techniques. Once the desired performance level was achieved, relative fishing power experiments comparing the new trawl to the Yankee No. 36 survey trawl were undertaken. These experiments were jointly conducted by scientists and research vessels from NMFS and the Atlantic Research Institute of Marine Fisheries and Oceanography (AtlantNIRO) Kaliningrad, USSR. Both the new trawl and the Yankee No. 36 were fished under controlled operational circumstances for 120 hours, and demonstrated the ability of the new trawl to take significantly larger quantities (weight) of most species that were available than did the No. 36 Yankee trawl. Throughout the development of the modified Yankee No. 41 trawl, considerable emphasis was placed on the standardization of trawl construction, performance confirmation, and state of repair. A final report describing procedures used and results obtained during the trawl development program has been completed and is currently undergoing review.

Studies of existing and potential techniques for fishery assessment by acoustic methods were continued by NMFS working in cooperation with scientists of the USSR. At the invitation of the Soviet Union, NMFS personnel and contractor (C.S. Draper Laboratory, Cambridge, Massachusetts) personnel boarded the USSR research vessel Khronometer at Las Palmas, Canary Islands, in May for a 17-day acoustic research voyage off the northwest coast of Africa. Using American instrumentation, data processing and recording systems, along with installed acoustics equipment aboard the Khronometer, operations were conducted over several fishing banks of the area to: (1) obtain accurate signals (echos) from aquatic animals identifiable by size and species of fish; (2) conduct combined parameter in situ calibration of hydroacoustic instruments employing physical targets of know backscattering characteristics; and (3) conduct measurements of ambient and vessel-generated noise in the operating area for determination of the lower limit of such noise associated with biomass detection and quantification systems. A joint authored US-USSR report was produced on the conduct, results, and analysis of this work.

Instrumentation projects by MESA, were aimed at the production and deployment of environmental sensing devices. In cooperation with the NOS, two experimental offshore tide telemetry systems were deployed during spring 1976. A second effort involved cooperation between MESA, NASA, and NESS and aimed at evaluating the applicability of satellite-and-airplane-borne remote sensing devices for obtaining data on features such as surface circulation patterns, chlorophyll a, and suspended particle distributions. Other efforts involved evaluating experimental bottom drifters and improving meteorological data gathering abilities.