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by

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The United States of America (US) landed fish from, and conducted research in, ICNAF Subareas 4 and 5 and Statistical Area 6. Table 1 summarizes US finfish, squid, and sea scallop nominal catches in 1977 and 1978.

Table 1. US finfish, squid, and sea scallop nominal catches for 1977 and 1978 [metric tons (MT), round fresh].

		Subarea or Statistical Area			
Species	Year	4	5	6	Total
Haddock	1977	1,663	11,232	1	12,896
	1978	1,216	16,695	-	17,911
Atlantic cod	1977	762	33,249	317	34,328
	1978	296	38,700	264	39,260
Redfish	1977	2,875	13,012	-	15,887
	1978	2,147	13,984	-	16,131
Pollock	1977	320	12,772	7	13,049
	1978	168	17,532	10	17,710
Yellowtail flounder	1977	13	16,056	535	16,604
	1978	3	11,064	424	11,491
Other flounder	1977	64	23,054	10,270	33,388
	1978	45	28,148	10,465	38,658
Silver hake	1977	14	15,504	6,425	21,943
	1978	-	16,347	7,658	24,005
Red hake	1977	4	2,293	1,119	3,416
	1978	3	3,620	930	4,553
Atlantic herring	1977	-	50,607	46	50,653
	1978	-	50,336	187	50,523
Atlantic mackerel	1977	-	694	682	1,376
	1978	-	947	659	1,606
River herring[a]	1977	-	1,679	4,793	6,472
	1978	-	1,619	4,110	5,729

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Atlantic menhaden	1977	-	14,041	248,821	262,862
	1978	-	43,454	219,982	263,436
Butterfish	1977	-	774	673	1,447
	1978	-	2,869	807	3,676
Other finfish	1977	274	21,365	39,004	60,643
	1978	89	23,282	43,245	66,616
Total finfish	1977	5,989	216,282	312,693	534,964
	1978	3,967	268,597	288,741	561,305
Loligo sp. squid	1977	-	788	68	856
	1978	-	522	203	725
Illex sp. squid	1977	4	1,009	14	1,023
	1978	-	359	2	361
Sp. not specified squid	1977	-	110	564	674
	1978	-	44	545	589
Sea scallop[b]	1977	-	43,300	48,892	92,192
	1978	-	48,653	71,971	120,624

[a]Combined alewife and blueback herring.
[b]In-the-shell weights.

I. SUBAREA 4

A. Status of the Fisheries

1. Haddock

The US landings for Subarea 4 declined from 1,663 MT in 1977 to 1,216 MT in 1978 (Table 2), apparently due to incidental trip limitations imposed for Division 4X in February and to later closure of Subarea 4 to US vessels. The landings were also slightly below the 10-yr average. The US autumn bottom trawl survey index was the highest recorded since 1968; values have increased substantially since 1975. The 1978 YOY (young-of-the-year) index for Division 4X declined substantially from the 1975-77 average.

Table 2. US haddock landings (MT, round fresh) and commercial and research-vessel-survey abundance indices for Subarea 4.

	Landings			Landings /day	Autumn survey	YOY
Year	Divisions 4V&W	Division 4X	Total	fished[a]	index[b]	index[c]
1969	-	1,830	1,830	3.4	12.8	3.3
1970	576	1,743	2,319	3.2	14.5	1.0
1971	497	751	1,248	2.5	17.1	6.1
1972	73	448	521	3.3	17.1	2.3
1973	173	269	442	2.5	18.9	1.8
1974	6	668	674	-[d]	17.2	2.9
1975	21	2,143	2,164	5.8	18.3	4.5
1976	32	986	1,018	5.2	21.9	3.5
1977	1	1,662	1,663	7.7	48.7	3.6
1978	82	1,134	1,216	-[d]	53.6	2.4

[a]Calculated from catch and effort data for Division 4X for large [≥151 gross (English) tons (GT)] otter trawlers from the Port of Boston, Massachusetts.
[b]Stratified mean catch (kg) per tow in Division 4X in US autumn bottom trawl surveys.
[c]Mean number of YOY haddock per tow in Division 4X in US autumn bottom trawl surveys (retransformed from log scale).
[d]Not calculated due to 10% trip limitation.

2. Atlantic Cod

The US fleet landed only 296 MT of Atlantic cod from Subarea 4 in 1978, compared to 762 MT in 1977.

3. Pollock

The US commercial pollock landings from Subarea 4 declined from 320 MT in 1977 to 168 MT in 1978 (Table 3). This catch represents approximately 1% of total US landings for this species. The US commercial abundance index showed its second largest decline in the past decade. The US autumn bottom trawl survey index increased moderately in 1978.

Table 3. US pollock commercial landings (MT, round fresh) and commercial and research-vessel-survey abundance indices for Subarea 4.

Year	Landings	Landings /day fished[a]	Autumn survey index[b]
1969	436	6.5	22.1
1970	384	5.9	3.3
1971	158	6.0	2.5
1972	486	7.7	4.2
1973	572	7.8	6.3
1974	676	7.6	2.6
1975	741	6.3	1.4
1976	619	6.6	2.9
1977	320	8.2	3.1
1978	168	7.3	3.9

[a]Calculated from US catch and effort data for medium and large (>50 GT) otter trawlers in Subareas 4 and 5.
[b]Stratified mean catch (kg) per tow in Division 4X in US autumn bottom trawl surveys.

B. Special Research Studies

All special research studies for Subareas 4 and 5 are combined with those for Statistical Area 6.

II. SUBAREA 5

A. Status of the Fisheries

1. Haddock

The US reported commercial landings for Subarea 5 increased from 11,232 MT in 1977 to 16,695 MT in 1978 (Table 4). This may be attributed to recruitment of the 1975 year class (which appears to have been strong both on Georges Bank and in the Gulf of Maine), as well as to increased catch quotas. The US autumn bottom trawl survey index for Division 5Y increased substantially in 1978 compared to the 1976-77 average, while the index for Division 5Z declined. The YOY index for Division 5Y remained the same, while for Division 5Z it was the second highest observed since 1968.

Table 4. US haddock landings (MT, round fresh) and research-vessel-survey abundance indices for Subarea 5.

	Landings			Autumn survey index[a]		YOY index[b]	
Year	Division 5Y	Division 5Z	Total	Division 5Y	Division 5Z	Division 5Y	Division 5Z
1969	2,423	16,456	18,879	8.5	5.6	1.0	1.1
1970	1,457	8,415	9,872	4.9	8.9	1.0	1.0
1971	1,194	7,306	8,500	5.4	3.7	1.2	1.4
1972	909	3,869	4,778	2.0	5.6	1.0	2.1
1973	509	2,777	3,286	5.7	6.5	1.6	1.8
1974	622	2,396	3,018	2.2	2.6	1.0	1.3
1975	1,180	3,989	5,169	5.7	10.0	2.2	3.8
1976	1,865	2,904	4,769	5.3	23.7	1.7	1.7
1977	3,297	7,935	11,232	7.3	23.1	1.1	1.1
1978	4,336[c]	12,159	16,695	18.2	15.2	1.1	2.3

[a]Stratified mean catch (kg) per tow in Subarea 5 in US autumn bottom trawl surveys.
[b]Mean number of YOY haddock per tow in US autumn bottom trawl surveys (retransformed from log scale).
[c]Includes landings from Division 5NK (43 MT).

2. Atlantic Cod

The US commercial landings of Atlantic cod from Subarea 5 in 1978 increased moderately from 1977 (Table 5). The US commercial abundance index from Georges Bank (Subdivision 5Ze) increased slightly. The US autumn bottom trawl survey index almost doubled from 1977.

Table 5. US Atlantic cod commercial landings (MT, round fresh) and commercial and research-vessel-survey abundance indices for Subarea 5.

		Division 5Z				
		Sub-division 5Zw	Subdivision 5Ze			Total landings for Subarea 5
Year	Division 5Y landings	landings	Landings	Landings /day fished	Autumn survey index[a]	
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	12,894	779	19,576	5.0	25.4	33,249
1978	13,330[b]	1,648	23,749	5.8	47.3	38,705

[a]Stratified mean catch (kg) per tow in Subarea 5 in US autumn bottom trawl surveys.
[b]Includes landings from Division 5NK (884 MT).

3. Redfish

The US redfish commercial landings from Subarea 5 increased slightly from 1977 to 1978 (Table 6). The US commercial abundance index in the Gulf of Maine (Division 5Y) increased slightly for the third consecutive year. Much of this increase can be attributed to continued recruitment of the 1971 year class, although it appears that this year class is now almost completely recruited to the fishery.

Table 6. US redfish commercial landings (MT, round fresh) and commercial abundance indices for Subarea 5.

	Division 5Y		
Year	Landings	Landings/day fished	Total landings for Subarea 5
1969	9,637	11.7	12,038
1970	13,551	9.2	15,534
1971	12,541	7.4	16,267
1972	7,150	6.3	13,161
1973	7,008	6.0	11,922
1974	5,464	5.4	8,690
1975	5,961	4.4	9,075
1976	7,985	4.7	10,131
1977	9,854	5.0	13,012
1978	11,359	5.1	13,992

The US autumn bottom trawl survey index for the Gulf of Maine (Division 5Y) indicated a stabilization of this stock, partially as a result of increasing availability of the 1971 year class through 1978 (Table 7). The US commercial and bottom trawl survey length-frequency samples indicate continued availability of this year class with a modal length of 24 cm in the autumn of 1978 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 research-vessel-survey abundance indices for Subarea 5.[a]

	Division 5Y		Subdivision 5Ze	
Year	Weight	Number	Weight	Number
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
1978	42.5	41.7	12.3	12.4

[a]Stratified mean catch per tow in weight (lb) or numbers in Subarea 5 in US autumn bottom trawl surveys.

4. Yellowtail Flounder

The US commercial catch of yellowtail flounder from Subarea 5 was significantly lower in 1978 (11,032 MT) than in 1977 (16,056 MT) (Table 8), due in part to lowered catch quotas. The US commercial abundance index remains near the lowest level observed. Food landings in 1978 decreased 33%, discards increased 44%, and industrial landings increased 18% from 1977.

The US autumn bottom trawl survey index showed some improvement from 1977 for the Southern New England stock (Division 5Z west of 69°), whereas the Georges Bank stock (Division 5Z east of 69°) showed a slight decrease in weight per tow and a moderate increase in number per tow (Table 9). Nonetheless, these indices remain among the lowest observed and do not indicate a significant increase in fishable stock. Stratified mean catch per survey tow of pre-recruits (age 1) indicates improved prospects for recruitment relative to recent years; however, the pre-recruit catch per tow in 1978 was still significantly lower than average levels prior to the 1970's (by a factor of 4.5 for Southern New England and 1.7 for Georges Bank).

Table 8. US yellowtail flounder landings (MT, round fresh) for Subarea 5.[a]

Year	Food landings	Estimated discards	Estimated industrial landings	Total catch
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	15,742	257	57	16,056
1978	10,594	371	67	11,032

[a]Excludes a small amount of catch from Division 5Y.

Table 9. US yellowtail flounder research-vessel-survey abundance indices for Division 5Z.[a]

	Division 5Z west of 69°		Division 5Z east of 69°	
Year	Weight	Number	Weight	Number
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
1978	6.6	11.4	4.8	7.2

[a]Stratified mean catch per tow in weight (lb) or numbers in Subarea 5 in US autumn bottom trawl surveys.

5. Silver Hake

The US commercial silver hake landings from Subarea 5 remained about the same in 1978 as in 1977 (Table 10). Division 5Y recorded the sharpest decrease in 1978, while Subdivision 5Ze showed the sharpest increase. Commercial abundance indices in 1978 (Table 10) continued trends begun in 1977 in all areas with major decreases in Division 5Y and Subdivision 5Ze, and an increase in Subdivision 5Zw.

Autumn bottom trawl survey indices for silver hake (Table 11) increased in 1978 in Subdivisions 5Ze and 5Zw after slight decreases in 1977. In Division 5Y, the index continued to

decrease in 1978 after recording its second highest level in the series in 1976. Indices from the spring surveys reflect the same changes as indicated in the commercial abundance indices, with decreases in both Division 5Y and Subdivision 5Ze, and an increase in Subdivision 5Zw-Division 6A.

Table 10. US silver hake commercial landings (MT, round fresh) and commercial abundance indices for Subarea 5.

	Division 5Y		Division 5Z					
			Subdiv. 5Ze		Subdiv. 5Zw			Total
Year	Landings	Landings/ day fished	Landings	Landings/ day fished	Food landings	Landings/ day fished[a]	Industrial landings	landings for Subarea 5
1969	14,632	10.1	1,654	13.3	1,261	6.2	2,809	20,356
1970	11,384	7.7	4,238	23.8	2,539	7.7	1,218	19,379
1971	8,263	8.6	3,069	17.4	1,077	4.9	923	13,332
1972	5,570	7.1	879	8.7	1,488	6.2	117	8,054
1973	8,347	9.9	5,698	22.6	1,119	4.8	795	15,959
1974	4,635	6.3	2,283	15.0	1,985	4.3	669	9,572
1975	8,042	7.8	4,588	22.7	2,035	5.7	1,522	16,187
1976	9,759	16.7	3,793	46.1	2,667	6.6	1,216	17,435
1977	8,728	15.9	3,749	31.6	1,914	7.6	1,113	15,504
1978	6,206[b]	7.6	6,394	20.2	2,081	8.4	835	15,516

[a]Include Division 6A statistics also.
[b]Includes landings from Division 5NK (14 MT).

Table 11. US silver hake research-vessel-survey abundance indices for Subarea 5 and Division 6A.[a]

	Division 5Y		Subdivision 5Ze		Subdivision 5Zw (and Division 6A)	
Year	Spring	Autumn	Spring	Autumn	Spring	Autumn
1969	0.2	2.4	0.5	1.7	3.8	2.3
1970	0.3	3.0	0.7	1.3	1.7	2.6
1971	0.4	2.7	0.8	1.2	3.7	4.6
1972	1.7	6.5	0.5	1.3	2.3	4.0
1973	0.7[b]	4.2	0.8[b]	1.8	1.2[b]	3.2
1974	0.7[b]	3.8	0.3[b]	1.1	1.7[b]	1.4
1975	2.4[b]	9.1	0.4[b]	2.0	3.1[b]	2.8
1976	2.4[b]	10.9	0.4[b]	4.4	2.0[b]	3.9
1977	1.0[b]	7.2	1.3[b]	1.9	1.2[b]	3.1
1978	0.2[b]	6.2	0.7[b]	3.0	1.8[b]	4.6

[a]Stratified mean catch (kg) per tow in Subarea 5 and Division 6A in US autumn and spring bottom trawl surveys.
[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 increased 53% from 1977 to 1978 (Table 12). The 1978 US autumn bottom trawl survey index exhibited decreases in the Gulf of Maine (Division 5Y), Georges Bank (Subdivision 5Ze), and Southern New England (Subdivision 5Zw) (Table 13). The spring survey index increased significantly, however, in Division 5Y and Subdivision 5Zw, while remaining the same in Subdivision 5Ze (Table 13).

Table 12. US red hake landings (MT, round fresh) and commercial abundance indices for Subarea 5.

	Food Fish		Industrial fish		
Year	Division 5Y landings	Subdivision 5Ze landings	Subdivision 5Zw landings	Landings /day fished	Total landings for Subarea 5
1969	143	51	4,732	8.2	4,926
1970	249	100	3,932	6.3	4,281
1971	268	111	2,404	8.4	2,783
1972	367	160	1,176	-	1,703
1973	279	74	2,377	-	2,730
1974	480	77	1,393	-	1,950
1975	395	55	1,311	-	1,761
1976	618	37	2,005	-	2,660
1977	802	96	1,395	-	2,293
1978	1,073	151	2,295	-	3,519

Table 13. US red hake research-vessel-survey abundance indices for Subarea 5.[a]

			Division 5Z			
	Division 5Y		Subdivision 5Ze		Subdivision 5Zw	
Year	Spring	Autumn	Spring	Autumn	Spring	Autumn
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	1.0[b]	3.2
1978	0.5[b]	2.2	0.1[b]	4.6	3.6[b]	2.1

[a]Stratified mean catch (kg) per tow in Subarea 5 in US autumn and spring bottom trawl surveys.
[b]Spring surveys made with Yankee No. 41 trawl have been adjusted to the Yankee No. 36 trawl.

7. Pollock

The US commercial landings of pollock from Subarea 5 continued the steady increase observed in recent years. Reported landings for 1978 totaled 17,532 MT (Table 14), a significant increase from 1977. The US commercial abundance index declined from 8.2 MT/day fished in 1977 to 7.3 MT/day fished in 1978, while the US autumn bottom trawl survey index declined from 9.5 kg/tow in 1977 to 6.2 kg/tow in 1978. The commercial abundance index was slightly above, and the autumn bottom trawl survey index was slightly below, the 10-yr average.

Table 14. US pollock commercial landings (MT, round fresh) and commercial and research-vessel-survey abundance indices for Subarea 5.

Year	Landings	Landings/day fished[a]	Autumn survey index[b]
1969	3,507	6.5	7.7
1970	3,592	5.9	2.2
1971	4,727	6.0	4.0
1972	5,242	7.7	4.9
1973	5,728	7.8	3.9
1974	8,050	7.6	3.5
1975	8,573	6.3	2.1
1976	10,241	6.6	19.3
1977	12,722	8.2	9.5
1978	17,532	7.3	6.2

[a]Calculated from US catch and effort data for medium and large (>50 GT) otter trawlers in Subareas 4 and 5.
[b]Stratified mean catch (kg) per tow in Subarea 5 in US autumn bottom trawl surveys.

8. Atlantic Herring

The US catch of Atlantic herring in Division 5Y decreased slightly (Table 15), due primarily to decreased catches in the juvenile fishery. As in 1977, concentrations of spawning herring did not appear on the traditional autumn spawning grounds on Georges Bank (Subdivision 5Ze).

The US autumn and spring bottom trawl survey indices (Table 16) increased significantly, indicating perhaps that rebuilding of the stock is occurring after 2 yr of reduced commercial exploitation.

Table 15. US Atlantic herring landings (MT, round fresh) for Subarea 5.

	Division	Division 5Z		Total
Year	5Y landings	Subdivision 5Ze landings	Subdivision 5Zw landings	landings for Subarea 5
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
1978	48,422[a]	2	1,931	50,355

[a]Includes landings for Division 5NK (7 MT).

Table 16. US Atlantic herring research-vessel-survey abundance indices for Division 5Z.[a]

Year	Subdivision 5Ze autumn survey index	Subdivision 5Zw spring survey index
1969	1.1	45.8
1970	0.7	34.7
1971	2.2	4.1
1972	1.1	5.7
1973	0.1	19.9
1974	0.1	9.9
1975	<0.1	0.3
1976	<0.1	2.0
1977	0.0	3.2
1978	1.7	12.2

[a]Stratified mean catch per tow in numbers in Subarea 5 in US autumn and spring bottom trawl surveys.

9. Atlantic Mackerel

The US commercial landings of Atlantic mackerel in Subarea 5 increased from 694 MT in 1977 to 947 MT in 1978 (Table 17). The US commercial abundance index for Subarea 5 and Statistical Area 6 remained at 0.5 MT/day in 1978 as in 1977. The US autumn and spring bottom trawl survey indices both underwent significant increases from 1977 to 1978, suggesting improvements in stock abundance (Table 18).

Table 17. US Atlantic mackerel commercial landings (MT, round fresh) for Subarea 5.

Year	Landings	Landings/day fished[a]
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
1978	947	0.5

[a]Includes Statistical Area 6 values also.

Table 18. US Atlantic mackerel research-vessel-survey abundance indices for Subarea 5.[a]

Year	Spring	Autumn
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
1978	0.4	0.2

[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 (kg) per tow in Subarea 5 (and in Statistical Area 6 to some extent) in US autumn and spring bottom trawl surveys.

10. Industrial Groundfish Fishery

Landings for industrial purposes from Subarea 5 (predominantly Subdivision 5Zw) continued to increase in 1978 from a low in 1976 (Table 19). Percentage composition for red hake increased from 28% in 1977 to 42% in 1978.

Table 19. US landings for industrial purposes (MT, round fresh) from Subarea 5.

	Total	Species composition (%) for Subdivision 5Zw				
Year	landings	Silver hake	Red hake	Flounders	Ocean pout	Others
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
1978	5,429	15.4	42.3	6.3	7.6	28.4

11. Squid

The US commercial landings of long-finned (Loligo sp.) squid decreased moderately from 1977 to 1978 as well as from the 10-yr average (Table 20), while landings of short-finned (Illex sp.) squid decreased greatly from 1977 to 1978 (Table 20), although they were slightly above the 10-yr average.

The US autumn bottom trawl survey index for Loligo sp. was down significantly from 1977 in both numbers and weight for Division 5Y and for the combined Subdivision 5Zw and Statistical Area 6 (Table 21). The Subdivision 5Ze index was up slightly from 1977 in both numbers and weight, although below the 10-yr average (Table 21).

The US autumn bottom trawl survey index for Illex sp. was down moderately from 1977 in both numbers and weight for Division 5Y, although above the 10-yr average (Table 22). The Subdivision 5Ze index increased significantly from 1977 in both numbers and weight. The combined index for Subdivision 5Zw and Statistical Area 6 was above the 10-yr average, but showed mixed changes from the 1977 marks (i.e., up in numbers and down in weight).

Table 20. US squid landings (MT, round fresh) by species[a] for Subarea 5 and Statistical Area 6.[b]

Year	Loligo sp.	Illex sp.
1969	898	562
1970	652	408
1971	727	455
1972	742	472
1973	1,100	530
1974	2,141	148
1975	1,620	108
1976	3,229	601
1977	1,474	1,079
1978[c]	1,274	514

[a]Includes estimated breakdown of catches of unspecified squid species.
[b]Landings for Loligo sp. and Illex sp. are given for Subarea 5 and Statistical Area 6 combined as statistics for some previous years were not available for each separate area.
[c]Preliminary data.

Table 21. US Loligo sp. squid research-vessel-survey abundance indices for Subarea 5 and Statistical Area 6.[a]

	Weight			Number		
Year	Division 5Y	Subdivision 5Ze	Subdivision 5Zw and Statistical Area 6	Division 5Y	Subdivision 5Ze	Subdivision 5Zw and Statistical Area 6
1969	<0.1	1.6	14.0	0.4	36.7	347.5
1970	<0.1	1.1	4.1	1.5	49.4	105.4
1971	<0.1	1.1	4.0	0.6	34.1	234.2
1972	0.0	1.1	9.4	0.2	39.3	389.9
1973	<0.1	4.5	14.2	0.9	60.9	542.9
1974	<0.1	2.2	11.4	0.8	62.1	355.9
1975	0.8	1.8	13.6	0.8	102.6	895.5
1976	0.4	3.1	15.8	12.7	103.5	579.8
1977	<0.1	1.0	11.9	0.8	43.8	577.9
1978	<0.1	1.6	5.7	0.2	45.6	198.4

[a]Stratified mean catch per tow in weight (kg) or numbers in Subarea 5 and Statistical Area 6 in US autumn bottom trawl surveys.

Table 22. US Illex sp. squid research-vessel-survey abundance indices for Subarea 5 and Statistical Area 6.[a]

	Weight			Number		
Year	Division 5Y	Subdivision 5Ze	Subdivision 5Zw and Statistical Area 6	Division 5Y	Subdivision 5Ze	Subdivision 5Zw and Statistical Area 6
1969	<0.1	<0.1	0.1	0.3	0.5	1.0
1970	0.3	0.2	0.3	0.8	2.6	3.8
1971	0.4	0.5	0.3	1.8	1.7	2.0
1972	0.2	0.2	0.5	0.8	1.1	4.9
1973	0.6	0.5	<0.1	2.0	2.5	0.6
1974	1.2	0.2	0.2	3.9	1.1	4.1
1975	2.7	1.1	1.0	7.3	6.4	15.7
1976	4.2	14.8	6.2	13.8	45.0	19.8
1977	2.2	5.0	4.5	7.2	15.8	15.8
1978	1.9	12.2	2.6	5.8	44.7	19.5

[a]Stratified mean catch per tow in weight (kg) or numbers in Subarea 5 and Statistical Area 6 in US autumn bottom trawl surveys.

12. Sea Scallops

The US sea scallop landings reached their highest level in the past decade (Table 23). Effort continued to increase significantly and, with the continued presence of the strong year class recruited in 1976, catch also increased.

Table 23. US sea scallop landings (MT of meats) and commercial abundance indices for Subarea 5.

Year	Landings	Landings/ day fished
1969	1,991	0.5
1970	1,553	0.6
1971	1,697	0.5
1972	1,347	0.5
1973	1,543	0.6
1974	1,153	0.7
1975	1,650	0.8
1976	2,061	1.1
1977	5,003	1.2
1978	5,839	1.1

B. Special Research Studies

All special research studies for Subareas 4 and 5 are combined with those for Statistical Area 6.

III. STATISTICAL AREA 6

A. Status of the Fisheries

1. Silver Hake

The US commercial landings of silver hake for food purposes from Statistical Area 6 increased in 1978 to their highest level in the past decade (Table 24). Landings for industrial purposes decreased sharply in 1978 after recording consistent levels for the past 3 yr.

Table 24. US silver hake commercial landings (MT, round fresh) for Statistical Area 6.

Year	Food landings	Industrial landings	Total landings
1969	2,793	372	3,165
1970	2,134	114	2,248
1971	2,749	240	2,989
1972	3,899	48	3,947
1973	4,085	99	4,184
1974	4,455	91	4,546
1975	4,513	208	4,721
1976	5,399	229	5,628
1977	6,148	277	6,425
1978	7,584	50	7,634

2. Red Hake

The US food landings of red hake from Statistical Area 6 increased significantly from 1977 to 1978 (Table 25) and were well above the 10-yr average. Industrial landings decreased greatly from 1977 to 1978 to their lowest level in the past decade.

Table 25. US red hake landings (MT, round fresh) for Statistical Area 6.

Year	Food landings	Industrial landings	Total landings
1969	256	503	759
1970	476	183	659
1971	502	319	821
1972	550	267	817
1973	706	520	1,226
1974	531	258	789
1975	565	189	754
1976	1,156	743	1,899
1977	655	464	1,119
1978	806	62	868

3. Atlantic Herring

The US landings of Atlantic herring from Statistical Area 6 increased from 46 MT in 1977 to 160 MT in 1978, but were still substantially below the 1973-76 average (Table 26). The US spring bottom trawl survey index increased fourfold from 1977 to 1978, but still remained below the 10-yr average.

Table 26. US Atlantic herring landings (MT, round fresh) and research-vessel-survey abundance indices for Statistical Area 6.

Year	Landings	Autumn survey index[a]
1969	-[b]	6.4
1970	-[b]	1.2
1971	-[b]	3.9
1972	-[b]	2.6
1973	529	5.6
1974	278	3.5
1975	488	<0.1
1976	187	1.5
1977	46	0.3
1978	160	1.1

[a]Stratified mean catch per tow in numbers in Statistical Area 6 in US autumn bottom trawl surveys.
[b]Quality of data not equivalent to that collected after 1972.

4. Atlantic Mackerel

The US commercial landings of Atlantic mackerel from Statistical Area 6 remained at about the same level in 1978 as in 1977 (Table 27). The commercial abundance index also remained unchanged from 1977 to 1978. The US autumn and spring bottom trawl survey indices increased significantly from 1977 to 1978 (Table 18 contains indices based on strata in both Subarea 5 and Statistical Area 6).

Table 27. US Atlantic mackerel commercial landings (MT, round fresh) and commercial abundance indices for Statistical Area 6.

Year	Landings	Landings/day fished[a]
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
1978	662	0.5

[a]Subarea 5 values also included.

5. Sea Scallops

Landings increased significantly to their highest historical level from 1977 to 1978 (Table 28). Effort also increased significantly and in greater proportion. Thus, the catch per unit of effort decreased slightly from 1977 to 1978.

Table 28. US sea scallop landings (MT of meats) and commercial abundance indices for Statistical Area 6.

Year	Landings	Landings/day fished
1969	1,895	-
1970	1,059	0.5
1971	895	0.4
1972	1,306	0.5
1973	857	0.5
1974	1,568	0.8
1975	2,706	0.9
1976	3,288	1.2
1977	5,780	1.3
1978	8,640	1.2

B. Special Research Studies

Because many of the special research studies conducted during 1978 were conducted throughout Subareas 4 and 5 and Statistical Area 6, these studies have been described together in the Statistical Area 6 description. Where specific research can be ascribed to a specific subarea, division, or subdivision, it has been done so.

1. Environmental Studies

a) Hydrographic studies

Physical oceanographic work was conducted by the National Marine Fisheries Service's Northeast Fisheries Center (NEFC), the Maine Department of Marine Resources (MDMR), and the New Jersey Department of Environmental Protection (NJDEP). The NEFC collected temperature, salinity, and dissolved oxygen profiles during seven cruises (four in the spring, one in the summer, and two in the autumn) on the continental shelf between Cape Sable and Cape Hatteras (Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C). The cruises were part of the Marine Resources Monitoring, Assessment, and Prediction Program (MARMAP) and were cooperative efforts with Poland, the Federal Republic of Germany (FRG), and the Union of Soviet Socialist Republics (USSR). The NEFC

also collected continuous subsurface (10 m) temperature records, and surface temperature, surface salinity, and expendable bathythermograph (XBT) records every 10 nautical miles (nm), during monthly cruises along transects between Cape Sable and Cape Ann (Divisions 4X and 5Y), between New York Harbor and Deepwater Dumpsite 106 (106 nm southeast of New York Harbor) (Division (6A), and on Georges Bank (Subdivision 5Ze). These cruises were part ofthe Ship-of-Opportunity Program. The NEFC further collected surface temperature, surface salinity, and XBT records during spring, summer, and autumn bottom trawl surveys on the continental shelf between Cape Sable and Cape Hatteras (Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C).

Studies of circulation by the NEFC included the completion of a 2-yr study of the oceanic water flux into the Gulf of Maine by means of mooring vector-averaging current meters at 100-230 m depths along the sill in the Northeast Channel between Georges Bank and Browns Bank Divisions 4X and 5Z). Results show that the high-velocity, intermittent inflow is coupled to storms and influenced seasonally. In addition, another NEFC circulation study used satellite infrared imagery to portray circulation conditions and events on the continental shelf and slope from Cape Sable to Cape Hatteras (Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C).

A final NEFC effort in physical oceanography was its support of the multinational (US, Canada, FRG, Poland, and USSR), multiship, larval Atlantic herring patch study through moored and drifting current measurements on Georges Bank (Subdivision 5Ze).

The MDMR collected temperature and salinity profiles during bottom trawl surveys in the western Gulf of Maine (Division 5Y). All inshore profiles were collected during July.

The NJDEP collected temperature, salinity, and dissolved oxygen data along the New Jersey Coast from 0 to 12 mi offshore (Division 6A).

b) Plankton studies

The NEFC conducted seven surveys (four in the spring, one in the summer, and two in the autumn) of the distribution, abundance, and production of phytoplankton, zooplankton, and ichthyoplankton between Cape Sable and Cape Hatteras (Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C). These MARMAP surveys were cooperative efforts with FRG, Poland, and the USSR. The MARMAP surveys showed sand lance to continue the trend begun in the mid-1970's of dominating the winter ichthyoplankton community by comprising 94% of the catch and being the only ichthyoplankter captured at 62% of the stations. The center of distribution of larval sand lance remained in Southern New England waters (Subdivision 5Zw) as in 1977, and densities exceeding 100 individuals per square meter blanketed the continental shelf. Production of sand lance did decline somewhat from the previous year's level, though, probably due to poor spawning success during December (1977) and January.

The NEFC collected continuous subsurface (10 m) plankton records during monthly cruises along transects between Cape Sable and Cape Ann (Divisions 4X and 5Y), New York Harbor and Deepwater Dumpsite 106 (Division 6A), and the mouth of Chesapeake Bay and the Gulf Stream (Divisions 6B and 6C). These cruises were part of the Plankton Environmental Monitoring Program in conjunction with the Ship-of-Opportunity Program.

The eighth calendar year of international larval Atlantic herring surveys on Georges Bank (Subdivision 5Ze) continued with involvement of the US, FRG, and Poland. Surveys were conducted from September through December. The NEFC also engaged with Canada, FRG, Poland, and the USSR to look at patches of larval herring intensity. Eight ships from these five nations conducted studies on Georges Bank and Nantucket Shoals (Subdivision 5Ze) during the autumn to: (1) map larval Atlantic herring and associated zooplankton for short-term population changes; (2) determine vertical and horizontal finescale structure of patches of such organisms; (3) perform finescale measurements of zooplankton and

phytoplankton distribution and abundance; and (4) associate physical oceanographic processes with the subsequent spatial distribution of plankton.

The MDMR conducted a survey of coastal abundance and distribution of larval Atlantic herring during March and April, and supplemented it with a similar survey in the Sheepscot estuary from October (1977) through March. Also, the MDMR surveyed the distribution of northern shrimp larvae and associated zooplankton and phytoplankton during February and March. All MDMR work occurred in Division 5Y.

c) Benthic studies

Generic studies of benthos by the NEFC focused on determining the caloric content of 30 species important in the Georges Bank benthic community and food web (Subdivision 5Ze) and on calculating the energy budget within Georges Bank benthic assemblages.

NEFC studies of benthic macroinvertebrates as a whole dealt with: (1) cruises in April and September to begin a long-term monitoring of community structure and dynamics at 28 stations on the continental shelf between between the Gulf of Maine and the Middle Atlantic Bight (Divisions 5Y, 5Z, 6A, 6B, and 6C); (2) summarization, evaluation, and reporting upon density and biomass in the Gulf of Maine–Georges Bank area (Division 5Y and Subdivision 5Ze); (3) analysis and reporting on New York Bight benthic macroinvertebrates (Division 6A); (4) development of an atlas of distribution, abundance, and life histories of dominant organisms in the New York Bight (Division 6A); (5) work on the distribution and abundance of Block Island Sound and Long Island Sound organisms, based on several years of samples (Subdivision 5Zw and Division 6A); (6) intensive sampling and analysis along the New Jersey Coast to determine the nature and extent of recolonization after the summer 1976 anoxic condition of bottom waters (Division 6A); (7) completion of baseline studies to assess distribution and abundance in the Baltimore Canyon Trough (Division 6B); and (8) processing and analyzing samples from Veatch Canyon (Subdivision 5Ze).

Research conducted generally on bivalve mollusks included analysis and reporting on the distribution of 227 species by the NEFC in Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C, and study of the population structure, standing stock, recruitment, and harvest impact in New Jersey estuaries (Division 6A) undertaken by the NJDEP.

Studies on sea scallops included: (1) research vessel surveys and stock assessment by the NEFC for the major grounds on Georges Bank (Subdivision 5Ze), in Southern New England waters (Subdivision 5Zw), and in the remainder of the Middle Atlantic Bight (Division 6A, 6B, and 6C); (2) studies by the MDMR on tagging methods, aging techniques, growth rates, population sizes, and harvest rates in the western Gulf of Maine (Division 5Y); (3) monitoring of resource status and collecting biological data by the New Hampshire Fish and Game Department (NHFGD) in the western Gulf of Maine (Division 5Y); and (4) resource surveys by Old Dominion University and the College of William and Mary in the waters off Virginia (Divisions 6B and 6C).

The Rhode Island Department of Natural Resources (RIDNR) conducted studies of the ocean quahog for information on resource status, natural mortality, meat yields, and meat quality indices. Research was performed on samples collected from Rhode Island Sound, Cox Ledge, Vineyard Sound, and Buzzards Bay (all Subdivision 5Zw).

Surf clams were studied by the NJDEP in that State's waters (Division 6A). Work focused on standing stocks, growth rates, mortality rates, and recruitment.

The NJDEP also studied the American oysters of Delaware Bay (Division 6B). Research included: (1) seed bed recruitment, growth rates, mortality rates, and harvest rates; and (2) associating the prevalence and intensity of the disease MSX with environmental and biological factors.

Research on crustaceans was primarily directed at lobsters, shrimp, crabs, and amphipods. The studies on American lobsters consisted of: (1) population information and harvest data collected by the MDMR in the western Gulf of Maine (Division 5Y); (2) larval sampling in Block Island Sound (Subdivision 5Zw and Division 6A), directed by the RIDNR and coordinated with the New York Department of Environmental Conservation (NYDEC) and Connecticut Department of Environmental Protection (CDEP); (3) collecting data on movement, growth rates, total mortality rates, natural mortality rates, and fishing mortality rates in western Long Island Sound (Division 6A) by the NYDEC; and (4) the completion of a 3-yr tagging study of 1,800 adults off New Jersey (Division 6A), conducted by the NJDEP.

Northern shrimp were studied by the MDMR for population and harvest information. Work was conducted in the western Gulf of Maine (Division 5Y).

Research on crabs comprised a summarization of existing biological and ecological information by the NEFC on the deepsea red crab from the Scotian Shelf to Cape Hatteras (Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C), and a study of population and harvest data by the MDMR on green, rock, and Jonah crabs in the western Gulf of Maine (Division 5Y).

Amphipod research concentrated on the NEFC's analysis and reporting on the quantitative distribution of 101 gammaridean species in the Middle Atlantic Bight (Subdivision 5Zw and Divisions 6A, 6B, and 6C), and on the NEFC's description of new haustoriid species in Long Island Sound and the New York Bight (Division 6A).

The MDMR continued its studies on the populations and harvests of sandworms and bloodworms in the western Gulf of Maine (Division 5Y).

e) Environmental studies

The NEFC continued at-sea and on-shore activities as part of its Ocean Pulse Program which monitors and assesses the health of living resources on the continental shelf between Maine and North Carolina (Divisions 5Y, 5Z, 6A, 6B, and 6C). Two test-phase cruises during April-May and September-October sampled 27 stations for species availability with plankton, benthos, epibenthos, and demersal finfish gear). Selected samples of bivalve mollusks, crustaceans, and finfishes were subjected to physiological measurements (gill-tissue oxygen consumption and hematological characteristics). Flounders, sea scallops, and Cancer spp. crabs were subjected to biochemical measurements (enzyme presence in various tissues). Bacteriological measurements were made on economically important finfishes and shellfishes, sediment samples, and water samples for baseline presence of Clostridium and Vibrio. Laboratory work focused on the sublethal physiological, biochemical, and uptake effects of such heavy metals as cadmium and lead on winter flounders and American lobsters.

Work on petroleum hydrocarbon pollution effects on fisheries resources included an assessment by the NEFC of the baseline conditions of sediment types, sediment-borne heavy metals, and benthic macroinvertebrates in the potential oil and natural gas development areas of the Baltimore Canyon Trough (Division 6B), and a joint study by the NEFC and the Battelle Pacific Northwest Laboratories, Inc., on the effects of napthalene and water-soluble crude on the chemosensory (i.e., food-gathering mechanism) behavior of red hake and blue crabs.

The NJDEP surveyed finfish and shellfish in Division 6A in an effort to determine the concentrations of polychlorinated biphenyls (PCB's) and other carcinogenic compounds in edible portions of collected specimens.

Research at specific major point sources of pollution included a study by the NEFC of the circulation and water mass properties at

Deepwater Dumpsite 106--a toxic material disposal site (Division 6A), and a study by the Massachusetts Division of Marine Fisheries (MDMF) of the density of ichthyoplankton, American lobster larvae, other meroplankton, and benthic fishes, and the catch per unit of effort for American lobsters and Irish moss, in the vicinity of the intake and outfalls of three major power plants (Division 5Y and Subdivision 5Zw).

2. Biological Studies

a) Atlantic cod

Researchers at the NEFC related the RNA-DNA ratio in laboratory-reared larvae to both the food availability and growth rate in an effort to develop an index of larval condition.

b) Yellowtail flounder

For the first time, the NEFC used the estimated production of eggs and larvae in order to estimate the actual size of the spawning stock in Divisions 5Y, 5Z, 6A, 6B, and 6C.

c) Winter flounder

NEFC scientists studied the physiology and biochemistry of the winter flounder by: (1) monitoring the growth and mortality of laboratory-reared larvae after such larvae were placed in an in situ environmental chamber in Narragansett Bay (Subdivision 5Zw); (2) developing a stochastic dynamic model of larval growth and mortality in laboratory-reared fish in order to determine the role of starvation as a regulatory mechanism in larval survival; and (3) relating the RNA-DNA ratio in laboratory-reared larvae to both the food availability and growth rate in an effort to develop an index of larval condition.

d) Silver hake

Within the past year, the NEFC has begun a study to differentiate better the stocks of economically important finfishes. The first such species to be considered, the silver hake, had extensive anatomical and morphometric measurements performed upon it. In the course of the NEFC's studies of the food and feeding habits of finfishes and squids, it was determined that if the silver hake population was not harvested, it could potentially consume 20 percent of the remaining fish biomass each year.

e) Atlantic herring

NEFC research focused on: (1) the occurrence of eggs in the sediment and in the stomachs of co-occurring predatory organisms on Jeffreys Ledge in the Gulf of Maine (Division 5Y); (2) the relationship between spawning stock size, larval production, and recruitment; (3) the role of ecological factors in larval survival on Georges Bank (Subdivision 5Ze); and (4) in cooperation with the MDMR, tagged 10 thousand juveniles along the Maine Coast (Division 5Y) and 10 thousand adults on Jeffreys Ledge in the Gulf of Maine (Division 5Y) from mid-September to mid-October. Only five percent of the adults were ripe, the rest were spent. Within one-week after tagging, 24 and 2% of the ripe and spent fish, respectively, had been recaptured.

f) Atlantic mackerel

Estimates of spawning stock size in Subarea 5 and Statistical Area 6 were derived by the NEFC from the total production of eggs and larvae, and compared favorably with estimates derived from cohort analysis of research and commercial data.

g) Spanish mackerels

The NEFC studied the systematics and taxonomy of these organisms.

h) Atlantic menhaden

Researchers of the NEFC identified an infectious agent which may be the cause of the central nervous system lesions associated with the mass mortalities of this species.

i) Sharks

The NEFC conducted a comprehensive worldwide study of the Scyliorhindidae (cat shark family)--the largest family of sharks. Also, two thousand volunteering anglers continued to assist the NEFC by tagging four thousand specimens representing 30 species, including 215 recaptured fish composing 25 species which had been at liberty for up to 6 yr and had moved as much as 3,000 mi. Information was collected on movements, food habits, growth rates, reproduction, and physiology. Subarea 5 and Statistical Area 6 were among those areas in which tagging and recapturing occurred.

j) Tunas and billfishes

The NEFC compiled a field guide to the tunas and billfishes taken by longliners in Subarea 5, Statistical Area 6, and waters further to the south.

k) Sand lances

Studies by the NEFC showed sand lance eggs and larvae to be the dominant ichthyoplankton during the winter by composing 94% of the larvae and being the only species present at 62% of the stations sampled in Divisions 4X, 5Y, 5Z, 6A, 6B, and 6C. The center of this species' abundance and production was in Southern New England waters (Subdivision 5Zw) where more than 100 ichthyoplankters per square meter of surface waters covered much of the continental shelf. However, it appears that the seasonal production declined from the previous years, likely due to a lack of spawning success in December and early January, since few individuals less than 10 mm were observed. Additionally, estimates of the spawning stock size were made based upon total production of eggs and larvae in Subarea 5 and Statistical Area 6.

l) Fourbeard rockling

Because the larvae of fourbeard rocklings can be easily confused with the larvae of some of the hakes, the NEFC studied the geographic variability in such larvae as an aid in proper identification in future sampling.

m) Bluefish

Research at the NEFC has focused on the attraction/avoidance of juvenile bluefish to thermal discontinuities as portrayed in the laboratory. Also, the body temperature of variously sized bluefish was measured relative to the ambient water temperature by implanting ultrasonic transmitters in the fish. The pulse frequency of the transmitted sound was directly proportional to body temperature.

n) Striped bass

The NYDEC studied the distribution, movements, size frequency, and exploitation rates of striped bass in western Long Island Sound (Division 6A). In addition, the NYDEC researched the migratory behavior of Hudson River fish (Division 6A).

The NEFC isolated and identified a bacterial pathogen which caused a significant die-off in Long Island Sound (Division 6A).

o) Tautog

The influence of temperature and photoperiod on the activity level, feeding habits, and social behavior of adult tautog was investigated by the NEFC.

3. Gear and Selectivity Studies

a) Trawls

Mesh selection factors for Atlantic cod, haddock, pollock, yellowtail flounder, winter flounder, and American plaice were determined by the NEFC. Cod ends of 130-140 mm size were compared to those of 100-110 mm size on board eight commercial bottom trawlers operating on Georges Bank (Subdivision 5Ze) and in Massachusetts and/or Cape Cod Bays (Division 5Y). The NEFC continued to develop a small beam trawl not only as a juvenile fish sampling device, but also as a flatfish-selective fishing gear. Double-rigged beam trawls have been shown to have a larger sweep than other comparable trawls. Work also continued by the NEFC in developing an improved trawl mensuration system.

The RIDNR studied the damage of otter trawls on variously sized American lobsters, particularly on soft-shelled (molting) individuals.

b) Dredges

The RIDNR tested and evaluated several methods, especially dredging, as a means of effectively harvesting conchs on different substrates.

A state-of-the-art surf clam and ocean quahog sampling dredge was designed and tested by the NEFC. Input by commercial fishermen lead to the development of the 60-inch blade,a 100-kW submersibly mounted water pump for hydraulic scouring of the bottom, an independent power cable on a slave winch to the towing cable winch, and an adaptive handling system for stern trawlers.

The NYDEC worked on a hydraulic dredge for sampling and harvesting both pre-recruit and recruited hard clams in nearshore waters.

c) Traps

The NEFC published a collection of papers on American lobster trap design and ghost fishing based on several years of research. Emphasis in the collected papers was placed on the effects of different types of vents on lobster escapement, on the use of time-release mechanisms, and the latent fishing mortality due to lost or abandoned traps.

4. Miscellaneous Studies

The MDMR began developing a data base on the biology, catches/landings, and economics of its commercial and recreational fisheries.

The NHFGD continued to try to establish and/or restore populations of such anadromous species as American shad, alewives, blueback herring, and coho salmon.

The NEFC maintained its long-term study of fishery climatology by trying to link variations in the distribution and abundance of fish stocks with the variations in the natural environment of those stocks for the period from 1946 to present.

The NEFC also worked on developing a simulation model of fish production based upon the food and feeding relationships among major species in the nektonic, planktonic, and benthic components of a continental shelf environment. The model is being designed to show how fishery management policies can ultimately affect the size, composition, and structure of the fishery biomass.