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The United States landed fish from ICNAF Subareas 4, 5, and Statistical Area 6. Research was conducted in Subareas 1, 3, 4, 5 and Statistical Area 6.

Table 0.1 gives a summary of U.S. finfish and sea scallops nominal catch for each Subarea for 1971 and 1972.

Table 0.1 - United States finfish & sea scallops nominal catch for 1972[1] and 1971 (metric tons, round weight)

SPECIES	YEAR	4	5	6	TOTAL
Haddock	1972	521	4771	1	5293
	1971	1248	8500	8	9756
Cod	1972	665	19704	241	20610
	1971	335	23175	383	23893
Redfish	1972	13476	13161	1	26638
	1971	10967	16267	-	27234
Pollock	1972	493	5233	1	5727
	1971	164	4727	5	4896
Yellowtail	1972	4	24206	8774	32984
	1971	12	22341	6867	29220
Other Flounder	1972	73	12888	4421	17382
	1971	141	15925	4698	20764
Silver Hake	1972	-	8036	277	8313
	1971	1	13332	2989	16322
Red Hake	1972	1	1711	817	2529
	1971	-	2783	821	3604
Sea Herring	1972		40473	522	40995
	1971		33890	1423	35313
Mackerel	1972		1020	976	1996
	1971		1593	809	2402
River Herring[2]	1972		1057	10610	11667
	1971		1005	11799	12804
Menhaden	1972		8962	320137	329099
	1971		6355	234396	240751
Other Finfish	1972	258	11789	29519	41566
	1971	181	17408	25495	43084
Total Finfish	1972	15491	153011	376297	544799
	1971	13049	167301	289693	470043
Sea Scallop	1972		11226	10884	22110
	1971		14142	7455	21597

1/ 1972 Data Preliminary

2/ Alewife & Blueback Herring

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Subarea 1

B. Special Research Studies

Atlantic Salmon

Four United States scientists took part in the International Salmon Tagging Program off West Greenland (Convention Area 1) during the summer and autumn of 1972. All U.S. members served aboard the Canadian R/V A.T. Cameron. The program included research vessels from Denmark, France, and the United Kingdom, as well as observers on fishing boats. About 2500 adult Atlantic salmon were tagged in the area of the high seas drift-net fishery. At year's end, 100 tags had been recovered off West Greenland, as had been anticipated by the ICES/ICNAF Salmon Committee. Recoveries are expected in the West Greenland, European, and North American fisheries in 1973, and in the European and North American fisheries in 1974.

Subarea 3

B. Special Research Studies

The United States Coast Guard conducted oceanographic surveys in support of the International Ice Patrol in Divisions 3N, L, and O.

Subarea 4

A. Status of the Fisheries

I. Haddock

United States nominal catch of haddock from Subarea 4 in 1972 was only 521 metric tons, a 50 percent decrease from 1971. Division 4X landings in 1972 were 448 tons, a decrease of 40 percent from 1971, while landings from Browns Bank, the principal area fished by U.S. vessels in Division 4X, decreased 36 percent from 1971 (Table 4.1). Commercial landings per day for Browns Bank increased somewhat in 1972 from 1971; however, this is based on limited effort. Research survey YOY index increased in 1971 but decreased for 1972, and indications are that abundance will continue low.

Table 4.1 - - United States haddock statistics, Division 4X (metric tons, round fresh).

	Division 4X		Browns Bank		
Year	Landings	Survey YOY Index[1/]	Landings	Days Fished	Landings/ Day Fished
1965	3,685	1.51	1,786	275	6.5
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

1/Mean catch per haul (linear scale, retransformed from log- scale)

II. Cod

The United States fleet landed 665 metric tons of cod from Subarea 4 in 1972, 330 tons more than in 1971. Albatross IV survey abundance estimates for the Scotian Shelf improved for 1971 over 1970. The 1972 index was similar to 1971.

III. Redfish

United States landings of redfish in 1972 from the Gulf of St. Lawrence (Divisions 4R, S, and T) were 1,111 metric tons, 76 percent below 1971 (Table 4.2). Landings from the Scotian Shelf (Divisions 4V, W, and X) by the United States were 12,365 metric tons, an increase of 97 percent (Table 4.3). Commercial landings per day indices are not very precise, probably because of limited fishing; however, research survey abundances for the Scotian shelf indicated declines in 1971 and again in 1972 after a rise in 1969 and 1970.

Table 4.2 -- United States redfish statistics, Division 4R, S, T (metric tons, round fresh).

Year	Landings	Days Fished	Landings/ Day Fished
1965	17,099	803	21.3
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

Table 4.3 -- United States redfish statistics, Division 4V, W, X (metric tons, round fresh).

Year	Landings	Days Fished	Commercial Lndgs/ Day Fished	Survey Wt/Tow *
1965	13,082	1.246	10.5	28.7
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

*Weight in pounds.

B. Special Research Studies

I. Environmental Studies

Environmental studies in Division 4X are part of a larger program carried out in Subarea 5 and 6. They are reported under Subarea 5.

II. Biological Studies

Haddock

A cooperative study was continued with Canadian scientists from the Biological Station at St. Andrews, New Brunswick, Canada, on the age-length-fecundity relationships for haddock stocks on Georges and Browns Banks. Differences in egg-counting techniques have yet to be resolved.

Sharks

The United States participated in a cooperative research cruise with Canada to tag blue and mako sharks and collect internal organs for reproductive studies. Twelve long-line sets were made along the north wall of the Gulf Stream (Virginia Capes to south of Sable Island) yielding 835 fish and 12 species; 150 sharks were examined on deck and 500 were tagged.

Subarea 5

A. Status of the Fisheries

I. Haddock

Haddock landings from Subarea 5 in 1972 were again limited by quota regulations set by the Commission, and the United States landed 4,771 metric tons, 44 percent less than in 1971 (Table 5.1). Landings per day figures in Table 5.1 were adjusted for effects of closures by deleting March, April, May, and calendar quarter 4, when fishing was curtailed in 1970 and 1972, and were calculated using a two-factor AOV model.

Age compositions from commercial landings still reflect the large 1962 and 1963 year classes; these continued to account for over 50 percent of the catch (Figure 5.1). The Albatross IV fall groundfish survey did show limited improvement in the 1971 and 1972 year classes over previous years; however, the 0-group index continues low (Table 5.2). Poor reproduction now extends to nine years, and recruitment will continue to be low through 1974.

Table 5.1 -- United States haddock statistics, Subarea 5 (metric tons, round weight).

Year	Subarea 5 landings	Division 5Y landings	Division 5Zw landings	Division 5Ze	
				Landings	Adjusted landing/ standard day fished
1965	57,027	4,204	26	52,797	5.68
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

Table 5.2 -- Research vessel index of relative year-class abundance of Georges Bank haddock based on autumn catches of 0-group fish.

Year	Index	Year	Index
1959	9.6	1965	1.2
1960	2.4	1966	1.7
1961	1.4	1967	1.0
1962	2.6	1968	1.0
1963	12.6	1969	1.1
1964	2.0	1970	1.0
		1971	1.4
		1972	1.6

II. Cod

United States landings of cod from Subarea 5 in 1972 declined 15 percent from 1971 (Table 5.3). Total catches by all countries in recent years have been high, exceeding or being close to the sustainable yield. U.S. Commercial landings per day 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 cod in the absence of haddock. The research survey index has remained relatively constant between 1968-1971, indicating a somewhat stable abundance. The 1972 index did show an increase; and with a catch quota beginning in 1973, abundance should continue at its present level or increase slightly.

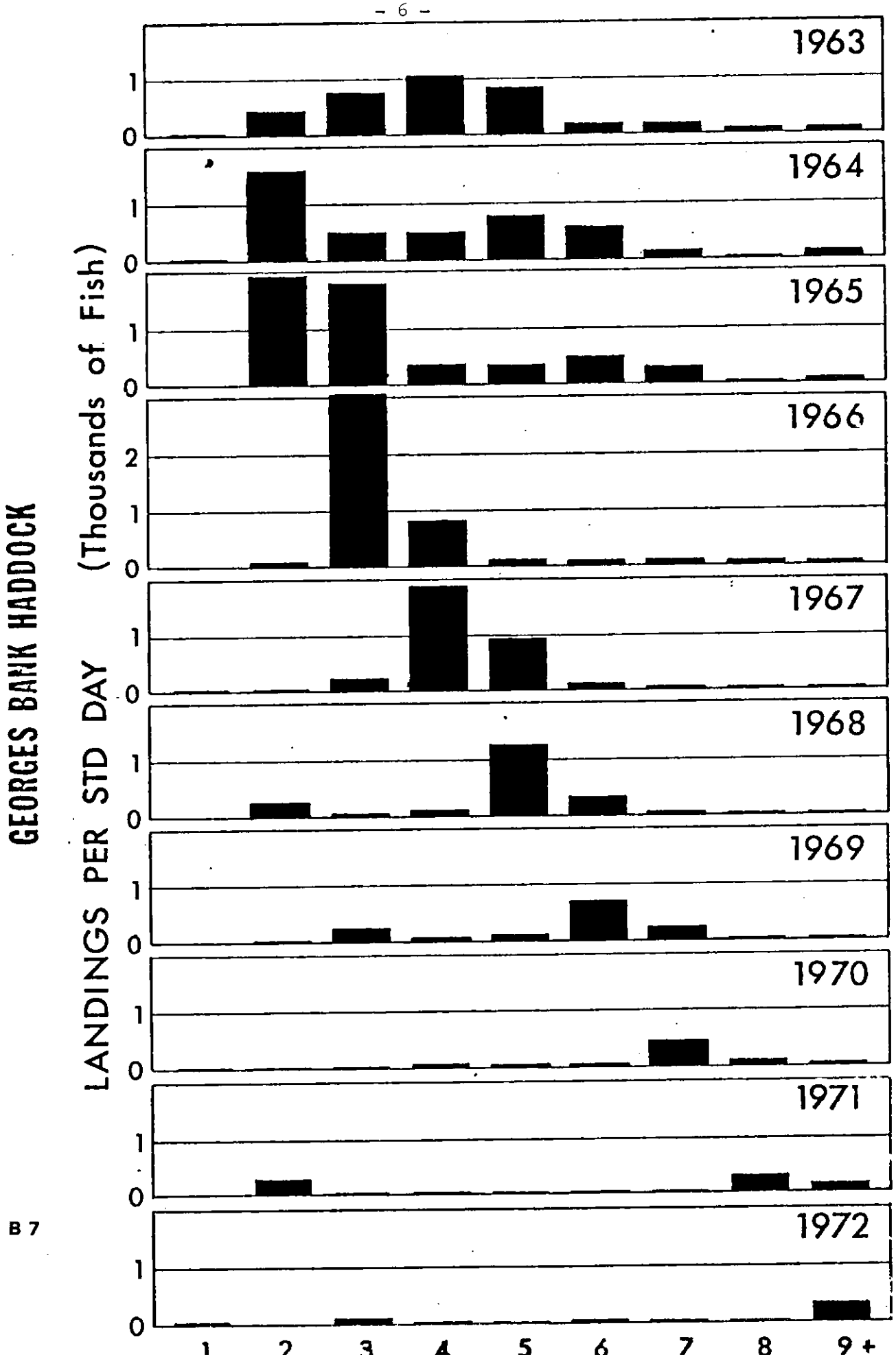

Figure 5.1 - Age composition of Georges Bank haddock.

Table 5.3 -- United States cod statistics, Subarea 5 (metric tons, round weight).

Year	SA 5 landings	Div. 5Y landings	Div. 5Zw landings	Division 5Ze		
				Landings	Landings/ day fished	Survey Wt/tow*
1965	15,011	3,780	215	11,016	0.9	15.9
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	1.7	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

* Weight in pounds

III. Silver Hake

Total U.S. silver hake landings from Subarea 5 in 1972 decreased about 5,300 metric tons (40 percent) from 1971 (Table 5.4). The decline was greatest in Division 5Ze (71 percent) followed by 33 percent and 20 percent in Divisions 5Y and 5Zw, respectively.

The commercial catch/effort index from food fish landings underwent a 65 percent increase in 1972 over 1971 in Divisions 5Y and 5Ze, in spite of decreased landings. A catch/effort index from Division 5Zw based on landings for industrial use was unavailable due to insufficient data.

Research vessel survey cruise data from fall 1972 indicate greatly improved stock abundance in Division 5Y as the result of the strong 1971 year class and the presence of a good 1972 year class in all areas of Subarea 5. High percentages of discard of undersized fish were reported in Division 5Ze during July-August relative to actual landings. Similar high removals of fish of the 1971 year class during 1972 by other nations fishing silver hake could have a detrimental effect on the stock abundance in 1973 and years following.

Table 5.4 -- United States silver hake statistics, Subarea 5 (metric tons, round weight).

Year	SA 5 landings	Food Fish			Industrial Fish	
		Div. 5Y landings	Div. 5Ze landings	Landings/ day	Div. 5Zw landings	Landings/ day
1965	41,809	22,605	11,169	11.3	8,035	4.4
1966	40,771	21,323	16,222	12.7	3,226	1.4
1967	30,986	14,390	12,692	9.3	3,904	3.4
1968	35,919	24,706	6,451	14.0	4,762	4.0
1969	20,333	14,609	1,654	4.9	4,070	4.6
1970	19,379	11,384	4,238	3.7	3,757	2.2
1971	13,332	8,263	3,069	2.6	2,000	3.4
1972	8,036	5,548	879	4.3	1,609	-

Table 5.5 -- Silver hake abundance indices (mean pounds/tow) from United States fall survey cruises.

Year	Division 5Y (Gulf of Maine)	Division 5Ze (Georges Bank)	Division 5Zw-6A (S. New England)
1965	18.9	3.8	16.8
1966	9.4	4.3	7.9
1967	2.8	5.9	9.8
1968	2.8	6.9	10.5
1969	4.3	5.3	5.1
1970	5.4	4.9	5.7
1971	5.4	4.0	10.1
1972	13.8	5.2	8.8

IV. Redfish

United States landings of redfish from Subarea 5 in 1972 were 19 percent less than in 1971 (Table 5.6). No assessment has been made on current status of the SA 5 stocks. The fishing character of the U.S. redfish fleet has changed, especially over the last two years: there have been changes in the number and size of vessels and ports of operation, more diversity in species composition, and new localized fishing areas. A greater percentage of the landings from SA 5 are being taken from northwest Georges Bank and off Cape Cod.

Fall Albatross IV groundfish surveys show variable abundance over the last five years for Georges Bank and Gulf of Maine with no clear trends (Table 5.7). Commercial catch/day indices for the Gulf of Maine shows a downward trend beginning in 1969. Good catches will probably continue to be made over Subarea 5 in 1973; however, without the frequency of former years.

Table 5.6 -- United States redfish statistics, Subarea 5 (metric tons, round weight).

Year	Total SA 5 Landings	Division 5Y (Gulf of Maine) Landings	Days Fished	Landings/Day Fished
1965	6,986	5,045	742	6.8
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

Table 5.7 -- Redfish abundance indices from United States fall survey cruises.

Year	Division 5Y(Gulf of Maine) Wt/Tow*	No./Tow	Division 5Ze (Georges Bank) Wt/Tow*	No./Tow
1965	30.8	62.1	2.5	4.1
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

V. Yellowtail Flounder

The United States total catch of yellowtail from Subarea 5 in 1972 was about 27,000 metric tons (Table 5.8), a seven percent decrease from 1971. Yellowtail landings for food increased 10 percent, while landings of yellowtail for industrial purposes declined 18 percent to a negligible amount.

Research survey abundance indices for the Georges Bank stock (east of 69°) suggest a slightly lower abundance in 1972 than in 1971 (Table 5.9) although the commercial catch/day index remained constant. The survey pre-recruit index (age 1+) declined for the fourth year, so indications point to a decreased abundance on Georges Bank for 1973 and possible 1974.

The Southern New England (west of 69°) survey abundance index was considerably higher in 1972 than in 1971; however, this sharp increase is very likely due to sampling error since pre-recruit indices in the previous two years have declined rather than increased, and catch rates have not reflected any increase. The fact that the increase in 1973 survey catches occurred for all size groups, not just incoming sizes, supports the contention that the greater abundance index reflects sampling variation. It is probable taht abundance will decline for the Southern New England stock in 1973.

Table 5.8 -- United States yellowtail flounder statistics, Subarea 5, (metric tons, round weight).

Year	Food Landings	Food Lndgs per day fished	Estimated discard	Est. Indus. landings	Total catch
1965	36,218	3.1	12,893	972	50,083
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

Table 5.9 -- Yellowtail flounder abundance indices from United States survey cruises.

	S. New England (W of 69°)		Georges Bank (E of 69°)	
Year	Nos. per tow	Wt.* per tow	Nos. per tow	Wt.* per tow
1963	50.6	32.1	30.1	22.0
1964	60.8	41.9	23.0	23.4
1965	38.7	28.0	15.0	15.7
1966	50.3	20.8	14.8	6.7
1967	57.7	31.0	19.2	13.0
1968	40.2	22.1	25.6	18.1
1969	54.8	31.7	23.1	16.0
1970	39.8	24.7	13.4	8.6
1971	41.7	20.2	15.2	11.0
1972	73.3	44.3	14.6	10.9

VI. Red Hake

Red hake landings by the United States in 1972 decreased 38 percent from 1971 in Subarea 5 to only 1,711 metric tons (Table 5.10). A 50 percent decrease in landings used primarily for industrial purposes in Division 5Zw resulted in insufficient data from which to calculate a satisfactory catch/effort index.

The 1972 fall research vessel survey cruise indicated a strong improvement in stock abundance in Division 5Zw and a slight decline in Division 5Ze. The survey abundance index has improved steadily in Division 5Y since 1968 and in 1972, for the first time, was higher than in Division 5Ze (Table 5.11).

Table 5.10 -- United States red hake statistics, Subarea 5 (metric tons, live weight).

		Food Fish		Industrial Fish	
Year	SA 5 landings	Div. 5Y landings	Div. 5Ze landings	Div. 5Zw landings	Landings/ day
1965	13,493	192	385	12,916	9.1
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	2,004	8.4
1972	1,711	373	160	1,178	-

Table 5.11 -- Red hake abundance indices (mean pounds/tow) from United States fall survey cruises.

Year	Division 5Y	Division 5Ze	Division 5Zw
1965	2.7	3.4	12.4
1966	2.1	2.4	6.4
1967	1.0	1.3	5.9
1968	0.6	2.2	9.7
1969	0.7	3.3	10.6
1970	1.0	1.1	8.6
1971	2.8	3.5	8.8
1972	4.7	2.2	14.6

VII. Sea Herring

The U.S. herring catch from Divisions 5Y in 1972 exceeded the catches for all years since 1963 except for 1968 (Table 5.12). While the catch from the adult fishery in 5Y was less than in 1971, it was greater than all previous years and the catch of herring from the Maine juvenile fishery increased to 19,513 metric tons in 1972 compared to 15,617 and 12,960 metric tons in 1970 and 1971, respectively. The catch of age 2 fish (1970 year class) along the Maine coast in 1972 was substantially greater than the previous three years although less than in 1968 (1966 year class). In terms of numbers, the 1970 year class may be no greater than perhaps half to three-quarters the abundance of the 1966 eyar class. The mean size of herring of the 1970 year class was very large, however, 18.4 cm in total length in

June in Western Maine at age 2 compared with an average of 15.5 cm over year classes 1960-1966 for the same month. Such unusually fast growth may produce early or more complete recruitment to the adult fishery. The age composition of the adult 5Y fishery indicates the continued decline in older fish and a greater dependence on recruitment and younger year classes. The good year classes of 1960-1963 produced 53%, 21% and 3% of the total catch (by weight) during 1970, 1971, and 1972. The very poor year classes of 1968-1969 produced 2%, 13% and 23% during the same period for this fishery.

The U.S. catch of herring from 5Z and Subarea 6 was 2,884 metric tons, about 25% below 1971.

Table 5.12 -- United States sea herring landings (metric tons, live weight) from Subarea 5.

Year	Subarea 5	Division 5Y	Division 5Ze	Division 5Zw
1965	34,495	33,634	861[1/]	
1966	30,589	29,365	1,224[1/]	
1967	31,778	31,158	620[1/]	
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[2/]	40,473	38,211	11	2,251

1/ 5Z 2/ Preliminary

Table 5.13 -- U. S. research cruise indices of herring abundance (mean number/tow).

Year	Fall Cruises Georges Bank	Spring Cruises S. 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	5.1	2.5

VIII. Industrial Groundfish Fishery

New England landings for industrial purposes from Subarea 5 (predominantly 5Zw) declined about 33 percent in 1972 (Table 5.14) due primarily to market conditions in the industrial industry. Eel pout continued to be the most important species caught while the flounders (other than yellowtail) increased in importance. Both silver and red hake registered decreases in 1972.

Table 5.14 -- New England groundfish landings from Subarea 5 for industrial purposes (metric tons, round weight).

Year	Total Landings	Species Composition (%) for 5Zw				
		Silver Hake	Red Hake	Flounder	Eel Pout	Other
1965	33,990	20.4	38.0	6.9	1.8	32.9
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

IX. Sea Scallops

United States sea scallop landings from Subarea 5, in 1972 were 11,226 metric tons (1,347 metric tons, meat weight), a decrease of 20 percent from 1971 (Table 5.15). Because of low abundance, the number of U.S. vessels fishing for scallops have declined significantly over the past five years.

Table 5.15 -- United States sea scallop statistics, Subarea 5 (metric tons, weight of adductor muscle only).

Year	Landings	Days Fished	Landings/Day Fished
1965	1,509	2,156	0.7
1966	901	1,001	0.9
1967	1,309	1,870	0.7
1968	1,163	1,938	0.6
1969	1,465	2,930	0.5
1970	1,553	2,588	0.6
1971	1,697	3,394	0.5
1972	1,347	2,694	0.5

B. Special Research Studies

I. Environmental Studies

The Oceanographic Observation Post Program was continued through the cooperation of the Woods Hole Oceanographic Institution and the United States Coast Guard. Oceanographic observations were made continually at ten lightships and light stations situated off the east coast of the United States. The data are under analysis and will be published by the United States Coast Guard. This project terminated in January, 1973.

The diving team began underwater surveys of proposed sand and gravel mining areas on Stellwagen Bank in order to make preliminary assessments of the living and non-living resources. Substrate and associated bottom fauna were photographed and documented at key locations on the bank. Scallops, sand dollars, skates, and longhorn sculpins were the dominant species in the proposed mining areas. Estimates of abundance of these species were made from visual counts by divers over half-mile transects while being towed just over the sea-bottom by their tender.

Temperature and salinity data collected on six offshore research cruises are being processed and plotted. The cruises were conducted in the area from Cape Hatteras to Western Nova Scotia (Subareas 5, 6, and Division 4X) within the period from March (spring groundfish survey) to December (ICNAF larval herring survey).

II. Biological Studies

Haddock

The United States continued studies of fecundity and spawning of fishes in the Northwest Atlantic, with emphasis on haddock and other gadoids. A survey to evaluate the size of the spawning stock and to obtain gonad samples was conducted at the end of February on Georges Bank when the haddock were starting to spawn; cod were midway through spawning and pollock were nearly finished. Monitoring of the progress of haddock spawning for 1972 ended in late June when all fish in the samples were spent.

Haddock spawning stocks on Georges and Brown Banks now consist largely of the 1963 and older year classes and the 1969 year class. There is some indication that haddock are now spawning at an earlier age, compared to ten years ago when the population was very much larger and consisted of many more year classes. Preliminary analysis also suggests possible changes in fecundity in relation to size.

About 1,100 young-of-the-year haddock stomachs have been examined for a comparison of growth and feeding of juvenile haddock before the major decline in total fish biomass (mid-1960) and after (1970). Food habits of juvenile fish of other species are also being studied as part of an investigation of the recruitment process.

Comparative studies of the effects of temperature and salinity (2-12°C and 26-36o/oo) on embryo mortality of cod and haddock were completed.

Experiments examining the influence of temperature on respiration and energy utilization of haddock from fertilization to complete yolk absorption were conducted at 4, 7 and 10° C. Daily specific growth rates for cod and haddock larvae were studied at 4, 7 and 10° C.

Herring

Studies on the spawning ecology and early life history of the Atlantic sea herring in the area of Jeffreys Ledge were conducted over a six-week period in early autumn. These operations were conducted by two vessels; one did otter trawl sampling of herring concentrations, dredge sampling of the substrate and herring eggs, and related oceanographic studies; the other served as a dive platform for SCUBA surveys.

Trawl collections of pre-spawning, spawning, and post-spawning herring showed that the 1967, 1968, and 1969 year classes were dominant in the samples (651 fish from 9 samples), followed in percentage occurrence by the 1966, 1970, and 1965 year classes, respectively. Herring eggs were found at two sites; at one, they were collected with a naturalist dredge; at the second, from the stomachs of trawl-caught codfish. All dredged eggs were obtained from pebble, rock, and boulder-strewn bottom.

Paired bongo tows were made at 69 stations and yielded a total of 4,461 herring larvae ranging in length from 5-25 mm (T.L.). Incidence of ripe and spent fish in close proximity to the egg beds and subsequent capture of yolk-sac larvae indicate that the peak of spawning occurred between 8-18 October.

SCUBA surveys and photographs of the seabed were made in potential spawning areas to depths of 20 fathoms.

Procedures for the aging of herring by means of otoliths were discussed by Canadian and United States scientists at the FRBC Laboratory in St. Andrews, New Brunswich, in December, 1972; and an ICNAF research document was prepared proposing standard methods for aging herring.

The United States continued biochemical studies on the stock structure of herring in the Gulf of Maine, Georges Bank, and adjacent areas. Analysis of variance of PHI allele frequencies (angular transformation) shows significant differences of area-allele interaction for the three major herring spawning groups (S.W. Nova Scotia, N. E. Georges Bank and S.W. Gulf of Maine).

Two cruises were conducted in May in the Gulf of Maine, Georges Bank, and Nantucket Shoals to study distribution and abundance of pelagic stages of larval fishes - particulary, sea herring - and to compare the sampling efficiency of bongo plankton nets with that of mid-water trawls. Larval densities were low; no herring larvae were observed caught over Georges Bank. The bongo nets and Isaacs-Kidd mid-water trawl apparently captured the same assemblages of plankton. Juvenile fish, however, were not captured in any more significant numbers by the mid-water trawl than the bongos.

From September through November, the United States conducted four inshore cruises in the Gulf of Maine to supplement the Fall 1972 ICNAF survey of abundance and distribution of larval herring. The United States leg of the offshore larval herring survey was conducted in December. Preliminary results are presented in research documents 73/11 and 73/12.

Yellowtail Flounder

Biochemical studies are initiated on yellowtail flounder to provide a better understanding of stock structure in this species. Two enzyme systems were found to be extensively polymorphic and useful for our studies. Nine phenotypes have been distinguished in each system. One system shows significant differences between Browns Bank samples and those from other areas. Gene frequency differences and population genetic analysis of the data obtained from the other system lead to the following preliminary interpretation. In the areas sampled, there are at least three stocks, Browns Bank, Georges Bank - Nantucket Shoals, and south of Hydson Canyon. Samples taken in the fall south of Long Island conform to the Georges Bank-Nantucket Shoals complex. In the spring, there appears to be intermixing of Georges Bank and southern stocks from south of Long Island to the vicinity of Hudson Canyon. The single sample available from the Cape Cod ground was not significantly different from the Georges Bank-Nantucket Shoals group. Further sampling and analysis will be required to fully clarify the stock structure and the extent of intermixing.

The effects of temperature and salinity in the respective ranges of 6-18^{o} C and 28-38 o/oo on embryo mortality of yellowtail flounder were examined in laboratory studies.

Assessment Studies

The major assessment efforts were devoted to the evaluation of the relationship between total effort and total catch (Research Document 73/8). It was concluded that 1971 effort levels in Subarea 5 and Statistical Area 6 exceeded 1954 levels by between 20 and 30 percent.

Preliminary mackerel assessment studies were conducted and presented as a research document. A MSY of 310,000 metric tons was estimated, however current sustainable yield would be in the neighborhood of 150,000 and 200,000 metric tons. The 1969 year class, while apparently larger than any since 1967, was estimated to be only 20 percent of the strength of that year class.

Other Biological Studies

The prototype of a density gradient fractionation for the separation of fish eggs and larvae from invertebrate plankton has been fabricated. Initial tests indicate we may soon be able to automatically sort fish eggs and larvae from the bulk of invertebrate zooplankton on a routine basis.

Information on biomass collected over the past ten years on macrobenthic invertebrate fauna has been prepared, assembled, and checked for a quantitative study of invertebrate fauna and relationships to bottom sediments, water depth, and geographical area.

Biomass estimates of long-finned squid, calculated on the basis of catches during 1967-71 groundfish surveys, were correlated with water temperature, water depth, and geographical area. A life history synopsis of long-finned squid is under preparation.

On a longline cruise from Hudson Canyon to southern Georges Bank for biological studies on large marine gamefish, shark and swordfish stomachs were found to contain the remains of squid, octopus, Atlantic and snake mackerel, butterfish, silver hake and sea herring.

On the annual spring and annual fall bottom trawl surveys between Nova Scotia and Cape Hatteras all groundfish were processed as follows: length and weight data were recorded, scale and otolith samples were taken, stomach samples were collected and preserved, and gonad maturity data were recorded. The fall survey was again conducted in cooperation with AtlantNIRO of the U.S.S.R. Selected species indices were used in stock assessment studies and given in the Status of Stock Section of this report.

Hematological studies have revealed piscine erythrocytic necrosis (PEN: confirmed in 1971 as a viral lesion of fish erythrocytes) in 6.6% of 256 cod taken from east of Nantucket Shoals to the northeast peak of Georges Bank. This is the first report of PEN in cod off the United States coast.

III. Gear and Selectivity Studies

The United States has initiated a study of the effect of the lobster resource of lost pots, and is testing methods of escapement in conventional pots and investigating the possiblity of non-entrapment pots.

The New England Fisheries Association has received an Economic Development Administration grant assistance from the National Marine Fisheries Service-Northeast Fisheries Center to conduct pelagic trawl experimental fishing for herring, pollock, redfish, mackerel. Expert advice was also provided by a Canadian pelagic trawl fisherman. Trawl comparison experiments were conducted between Albatross IV and a Canadian vessle and between Delaware II and a Soviet vessel. In July, Albatross IV towed side-by-side with the Canadian R/V A. T. Cameron for 25 stations on the Canadian groundfish survey to test the relative fishing power of the two standard groundfish survey trawls. Preliminary analysis indicates that, though there were no significant differences for important species, the difference in total catch was significant; the Canadian gear caught twice as much as the Albatross IV. In September, Delaware II and Blesk conducted an experiment to test the relative fishing power of a modified two-seam high rise Yankee 41 trawl and the Soviet 27.1. Final analysis of the results has not been completed, but preliminary results show that, in terms of fishing power, the two nets were comparable. In a comparison of the four-seam modified 41 high

opening bottom trawl on Albatross IV with the standard 36 groundfish survey trawl on Delaware II, the fishing power of the modified 41 was 1.5-3.0 times better than the 36 for most species.

Subarea 6

A. Special Research Studies

I. Environmental Studies

On ichthyoplankton sampling cruises between Cape Cod and the Caribbean for the Marine Resources monitoring and Prediction Program (MARMAP), plastic and oil contaminants were found during July and August in Subarea 6.