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The United States landed fish from all ICNAF Statistical Subareas and conducted research in Subareas 1, 3, 4, and 5.

Subarea 1

A. Status of the Fisheries

The United States landed 200 metric tons of cod from the subarea, probably the first U.S. landings from the subarea ever recorded.

B. Special Research Studies

The United States Coast Guard conducted oceanographic surveys from Melville Bay to Disco Island in conjunction with the International Ice Patrol West Greenland Glacier Survey. The Bureau of Commercial Fisheries cooperated to the extent of providing scientific personnel to collect benthic and sediment samples. The work was performed during the month of August.

Subarea 2

A. Status of the Fisheries

The United States landed 342 tons of cod from the subarea, the first since the establishment of ICNAF. The catch was primarily cod.

Subarea 3

A. Status of the Fisheries

I. Redfish

Redfish landings by the United States from Subarea 3 were considerably lower in 1969 than in 1968 (Table 3.1). Because of the very low fishing effort, landings per day fished is not a meaningful index of abundance.

Table 3.1 U.S. redfish statistics, Subarea 3 (metric tons, round fresh).

<u>Year</u>	<u>Landings</u>	<u>Days Fished</u>	<u>Landings/Day Fished</u>
1963	12,089	882	13.7
1964	4,692	364	12.7
1965	772	51	15.0
1966	346	38	9.1
1967	150	16	9.3
1968	198	15	13.1
1969	33	1+	22.7

Subarea 4

A. Status of the Fisheries

I. Haddock

United States landings of haddock from Division 4X, decreased by 1300 metric tons (Table 4.1). Landings from Browns Bank, the principal area fished by the U.S. fleet within this Division, decreased by 1000 metric tons. Both effort and abundance also showed reductions from 1968. Albatross IV groundfish surveys showed a slight improvement in the 1969 year class; however, abundance will continue to decline for the next 3 or 4 years due to generally poor recruitment.

Table 4.1 U.S. haddock statistics, Division 4X (metric tons, round fresh).

<u>Year</u>	<u>Division 4X Landings</u>	<u>Browns Bank</u>		<u>Landings/ Day Fished</u>
		<u>Landings</u>	<u>Days Fished</u>	
1964	8,488	6,978	930	7.5
1965	3,685	1,786	275	6.5
1966	2,473	939	200	4.7
1967	5,014	2,059	381	5.4
1968	3,156	2,278	506	4.5
1969	1,830	1,305	389	3.4

II. Cod

U.S. fishing vessels landed 448 metric tons of cod from Subarea 4 in 1969 compared with 860 metric tons in 1968. This decrease in cod landings was probably due to the continued decline in fishing effort for haddock in this area.

III. Redfish

Redfish landings from the Gulf of St. Lawrence (Divisions 4R, S, and T) by the United States decreased in 1969 (Table 4.2). Effort and abundance also decreased. U.S. redfish landings and effort from the Scotian Shelf (Divisions 4V, W, and X) continued a decline that started in 1967 (Table 4.3). Because of the low effort; however, landings per day is probably not indicative of true abundance.

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

<u>Year</u>	<u>Landings</u>	<u>Days Fished</u>	<u>Landings/ Day Fished</u>
1964	12,278	735	16.7
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

Table 4.3 U.S. redfish statistics, Division 4V, W, X (metric tons, round fresh).

<u>Year</u>	<u>Landings</u>	<u>Days Fished</u>	<u>Landings/ Day Fished</u>
1964	15,636	2,369	6.6
1965	13,082	1,246	10.5
1966	16,680	1,183	14.1
1967	6,407	593	10.8
1968	4,635	297	15.8
1969	1,142	75	15.3

B. Special Research Studies

I. Environmental Studies

Many of the United States investigations in Subarea 5 included the southern part of Subarea 4 and are reported under Subarea 5.

II. Biological Studies

Haddock. The cooperative studies of haddock in Division 4X by Canada and the U.S. have continued. A revision of the status of fisheries, and an assessment of fishing intensity corresponding to maximized yield has been completed. These estimates indicate the 18,000 ton annual quota set for 1970-72 is too high--the figure for 1970 should be about 12,000 tons.

In addition, data from the U.S. research vessel surveys have been analyzed to provide estimates of mortality, abundance and recruitment. Year classes since 1963 have been consistently poor, although some improvement in the 1969 year class was noted. Recruitment to the fishery will thus be poor for several more years, and abundance will decline--the rate being dependent on the fishing intensity.

The data also indicate a rather high natural mortality of 1 and 2 year olds during 1964 and 1965. This aspect requires further study.

Subarea 5

A. Status of the Fisheries

I. Haddock

Georges Bank (Division 5Ze) haddock landings by the United States continued their predicted sharp decline (Table 5.1). Effort was curtailed drastically during 1969 and abundance was lower. The landings per day index does not reflect true abundance because of low effort and a change in the characteristic of the U.S. fishing fleet. Another index method will be used in the future (see biological studies).

Age compositions from commercial landings (Figure 1) indicate that 6- and 7-year old fish (1963 and 1962 year classes) made up 68 percent of the 1969 catch. The Albatross IV fall groundfish survey showed a below average 1969 year class; the sixth successive year of poor recruitment (Table 5.2). This means a continued reduction in abundance for at least two more years on Georges Bank.

Table 5.1 U.S. haddock statistics, Division 5Y and 5Z (metric tons, round weight).

<u>Year</u>	<u>Subarea 5 Landings</u>	<u>Div. 5Y Landings</u>	<u>Divisions 5Z^{1/}</u>		
			<u>Landings</u>	<u>Days Fished</u>	<u>Landings/ Day Fished</u>
1964	51,895	5,383	46,512	8,775	5.3
1965	57,027	4,204	52,823	9,432	5.6
1966	57,497	4,579	52,918	11,759	4.5
1967	39,580	4,852	34,728	9,386	3.7
1968	28,887	3,418	25,469	9,096	2.8
1969	18,858	2,402	16,456	5,308	3.1

^{1/} Predominately 5Ze landings.

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

<u>Year</u>	<u>Index</u>	<u>Year</u>	<u>Index</u>
1959	9.6	1964	2.0
1960	2.4	1965	1.2
1961	1.4	1966	1.5
1962	2.6	1967	0.0
1963	12.6	1968	1.0
		1969	1.1

II. Cod

Cod landings by the United States in Subarea 5 increased in 1969 for the third straight year (Table 5.3). The abundance index, although not precise, was slightly higher than in 1968.

Landings of cod have increased drastically with the influx of heavy haddock fishing in the mid-sixties. Increased pressure is continuing on cod now, and with the low stock density of haddock, the cod is bringing better market prices. Although we do not have an accurate assessment of sustainable yield, it is doubtful that the present yield trends can continue into the near future.

Table 5.3 Cod landings, Subarea 5 (metric tons, round weight).

<u>Year</u>	<u>All Countries Landings</u>	<u>United States</u>	
		<u>Landings</u>	<u>Landings/Day Fished</u>
1964	28,416	15,478	1.0
1965	42,261	15,011	0.9
1966	57,055	15,343	1.1
1967	42,051	18,057	1.0
1968	48,900	21,045	1.4
1969	--	24,179	1.7

III. Silver hake

Total U.S. landings of silver hake from Subarea 5 in 1969 decreased about 15 thousand metric tons from 1968 (Table 5.4). Most of this decline was in landings of food fish in the Gulf of Maine. Abundance here decreased sharply due to poor recruitment since 1962. In the southern area landings decreased only slightly.

Table 5.4 U.S. silver hake statistics, Subarea 5 (metric tons, round weight).

<u>Year</u>	<u>Subarea 5 Landings</u>	<u>Subarea 5 North^{1/}</u>		<u>Subarea 5 South^{2/}</u>	
		<u>Landings</u>	<u>Landings/Day</u>	<u>Landings</u>	<u>Landings/Day</u>
1964	53,145	39,479	15.1	13,666	11.5
1965	41,809	33,774	11.3	8,035	4.4
1966	40,771	37,545	12.7	3,226	1.4
1967	30,986	27,082	9.3	3,904	3.4
1968	35,902	32,426	14.0	4,762	4.0
1969	20,333	16,263	4.9	4,070	4.6

^{1/} Primarily food fish from north of Cape Cod.

^{2/} Primarily for industrial use from south of Cape Cod.

IV. Redfish

Redfish landings from Subarea 5 by the United States doubled and effort increased significantly in 1969 when compared with 1968. Landings per day were slightly lower in 1969; however, abundance is still high, and continued good catches in the Gulf of Maine can be expected for 1970.

Table 5.5 U.S. redfish statistics, Subarea 5 (metric tons, round weight).

Year	Total Subarea 5 Landings	Division 5Y (Gulf of Maine)		
		Landings	Days Fished	Landings/Day Fished
1964	7,812	6,137	1,427	4.3
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

V. Yellowtail

Total U.S. yellowtail landings in 1969 from Subarea 5 increased one thousand metric tons over 1968 (Table 5.6). This increase was primarily caused by additional effort on Georges Bank. Abundance was slightly lower and evidence points to lower recruitment in 1969.

Research studies have indicated a marked decrease in abundance, particularly of older age groups, associated with the high fishing intensity of the last few years. These studies suggest the need for curtailing fishing on this tock to maintain yields.

Table 5.6 U.S. yellowtail statistics, Subarea 5 (metric tons, round weight).

Year	Landings	Days Fished	Landings/Day Fished
1964	36,340	9,822	3.7
1965	37,190 ^{1/}	11,997	3.1
1966	31,020 ^{1/}	15,510	2.0
1967	25,376 ^{1/}	11,534	2.2
1968	32,578 ^{1/}	10,859	3.0
1969	33,004 ^{1/}	12,224	2.7

^{1/} 1965-1969 values include some landings for industrial purposes.

VI. Red hake

Subarea 5 red hake landings by the United States decreased about 1300 metric tons from 1968 landings (Table 5.7). Effort dropped in 1969; however, abundance continued to exhibit a slight rise that started in 1967.

Table 5.7 U.S. red hake statistics, Subarea 5 (metric tons, round weight).

Year	Subarea 5 Landings	Div. 5Y Landings	Division 5Z ^{1/}		
			Landings	Days Fished	Landings/Day Fished
1964	24,573	143	24,430	1,733	14.1
1965	13,493	192	13,301	1,462	9.1
1966	4,280	634	3,646	1,585	2.3
1967	5,759	92	5,667	1,012	5.6
1968	6,216	82	6,134	876	7.0
1969	4,923	140	4,783	583	8.2

^{1/} Predominantly industrial landings from 5Zw.

VII. Industrial Groundfish Fishery

New England industrial groundfish landings from Subarea 5 were about 8000 metric tons less in 1969 than in 1968 (Table 5.8). This is a reflection of market conditions since abundance indices were similar to 1968's level. Species composition was similar to that of the past two years, although the percentage of flounders increased slightly and that of eel pout decreased.

Table 5.8 New England groundfish landings from Subarea 5 for industrial purposes (metric tons, round weight).

Year	Total Landings	Species Composition (%)				
		Silver hake	Red hake	Flounder	Eel pout	Other
1964	24,890	20.0	42.6	11.6	0.9	24.9
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

VIII. Sea scallops

United States sea scallop landings from Georges Bank were 300 metric tons higher in 1969 than in 1968 (Table 5.9). Effort, however, increased significantly and abundance was probably somewhat lower than in 1968.

Table 5.9 U.S. sea scallop statistics, Subarea 5 (metric tons, weight of adductor muscle only).

Year	Landings	Days Fished	Landings/Day Fished	Research Vessel Index
1964	6,296	6,296	1.0	40.0
1965	1,509	2,156	0.7	33.5
1966	901	1,001	0.9	48.0
1967	1,309	1,870	0.7	63.0
1968	1,163	1,938	0.6	44.7
1969	1,465	2,930	0.5	-- ^{1/}

^{1/} There was no research vessel cruise for scallop abundance estimate in 1969.

IX. Herring

The catch of Maine herring continued poor; only 24,000 metric tons were caught in 1969. Since 1964, when the catch of herring dropped to 28,000 metric tons from a previous 10-year average of 52,000 tons, the catch has remained at a low level, fluctuating between 24,000 and 32,000 metric tons. The reasons for the continued poor catch are unknown but it does not appear that the decline is due to overfishing by the Maine "sardine" fishery. Water temperatures fell steadily from 1953 through 1968 and may be a factor. Larger herring (ages 3 and 4) are being caught as a result of the low juvenile herring abundance and more purse seines are entering the fishery to search for herring further offshore.

The fishery for adult herring from Jeffreys Ledge, and adjacent areas of the Gulf of Maine, continued. The catch by United States vessels declined to about 4100 metric tons.

B. Special Research Studies

I. Environmental Studies

The Albatross IV made temperature observations on all cruises conducted in the area. Quantitative plankton samples were taken at all trawl stations on the groundfish surveys (spring and fall).

The United States Coast Guard conducted two extensive surveys covering the area from Nova Scotia to Cape Hatteras. Results of these cruises will be published in U.S. Coast Guard Bulletin.

Recording of a number of environmental factors was continued at the Bureau of Commercial Fisheries Laboratory at Boothbay Harbor, Maine. The mean surface sea temperature in 1969 was 8.9° C continuing the upward trend that started in 1967.

The Oceanographic Observation Post Program was continued through the cooperation of the Woods Hole Oceanographic Institution and the United States Coast Guard. Oceanographic observations are made continually at 11 lightships and light stations situated off the East Coast of the United States. Analysis of the data is made by the Oceanographic Institution and published by the Coast Guard.

Monitoring the abundance and distribution of zooplankton in the coastal waters of the Gulf of Maine was continued. As in previous years, copepods were the predominant zooplankters. Zooplankton biomass was significantly higher in the summer and autumn of 1969 than in 1968. Coastal waters were warmer and thermocline formation earlier than in 1968, favoring the development of unusually high phytoplankton blooms that may have favored the survival of zooplankton.

The United States and U.S.S.R. conducted further experiments in developing quantitative plankton gear using the Albatross IV and the Soviet vessel Prognoz. These experiments were conducted in the spring on Georges Bank and are further reported in another research document.

II. Biological Studies

Haddock. A special study to devise a more accurate measure of relative population density for commercial catch per unit effort data is nearing completion. The index would be based on estimates derived from a factorial model incorporating area, vessel size and depth, and all vessels would be utilized. This appears better than the previous system of using only selected vessels, most of which are not now fishing.

Further studies of haddock population dynamics have continued, as well as routine monitoring of the fishery.

Studies of the spawning of Georges Bank haddock were continued. The following aspects of this spawning stock were noted:

1. The largest haddock spawn first, usually in shoal water on top of the banks, both inshore and offshore.

2. Prior to the onset of spawning, ripening haddock of all sizes are found in the deep waters along the Northern Edge of Georges Bank and in South Channel. The state of maturity of fish from deep water is usually one or two stages behind those from the shoals.

3. Ripening of the fish and their movement from deep water appear to be associated with seasonal warming of the bottom waters. However, this does not explain the early spawning of large haddock on the shoals.

4. The number of immature haddock in the samples has decreased steadily since sampling began in 1968. Less than 2% of the fish samples through March this year have been immature.

Yellowtail flounder. Analysis of tag returns from tagging conducted in the late 1950's was completed. Total and fishing mortality rates were estimated from these tagging studies and from virtual population estimates.

The analyses show a high total mortality rate and indicate very high fishing mortality.

Yield per recruit values were calculated using the Beverton and Holt model. The results indicate that an increased yield would occur with an increase in the age of capture and that a reduction in fishing mortality would also result in increased yield per recruit.

Further reporting of these studies is presented in another research document.

Cooperative Groundfish Surveys. The United States continued its cooperative work with the Soviet Union in conducting closely coordinated surveys of the groundfish in the area from Nova Scotia to Cape Hatteras as explained in a separate research document.

Herring. Studies on the population structure of herring in the Gulf of Maine and adjacent areas continued using meristic and biochemical methods. Significant differences in the frequencies of two types of enzymes were found between the Georges Bank stock and herring within the Gulf of Maine-Southwest Nova Scotia. These enzymes were an esterase and lactic dehydrogenase. Two additional enzymes (phosphoglucosmutase and phosphohexoseisomerase) were found to be polymorphic in the herring of the Northwest Atlantic and samples are being run to compare the frequencies of the variant enzyme types in stocks from several areas.

A coordinated vessel survey of herring spawn on Georges Bank was conducted in the fall in cooperation with the Soviet Union using the vessels Albatross IV. The Soviet vessels participating were the Ekliptika and the Aliot.

Lobster. The extensive tagging program on offshore lobsters was continued. By the end of 1969, 410 returns had been made from the 5,710 released. The distribution of tag returns indicates that deep-water lobsters move into shoal water in the spring and early summer and back into deep water in the fall and early winter. Of the 320 returns for which locations of recapture are known, 22 percent had moved distances less than 10 nautical miles, 58 percent between 10 and 50 miles, and 20 percent in excess of 50 miles. Lobsters demonstrating the most extensive migrations were predominantly females. The migratory behavior of these "offshore" lobsters contrasts markedly with that of "inshore" lobsters that are essentially non-migratory.

A study of the effects of exploitation on size composition and sex ratio of the offshore lobster stocks has been conducted. Differences in size-composition and sex ratio among offshore fishing grounds are hypothesized as due to differences in the extent of exploitation.

GEORGES BANK HADDOCK

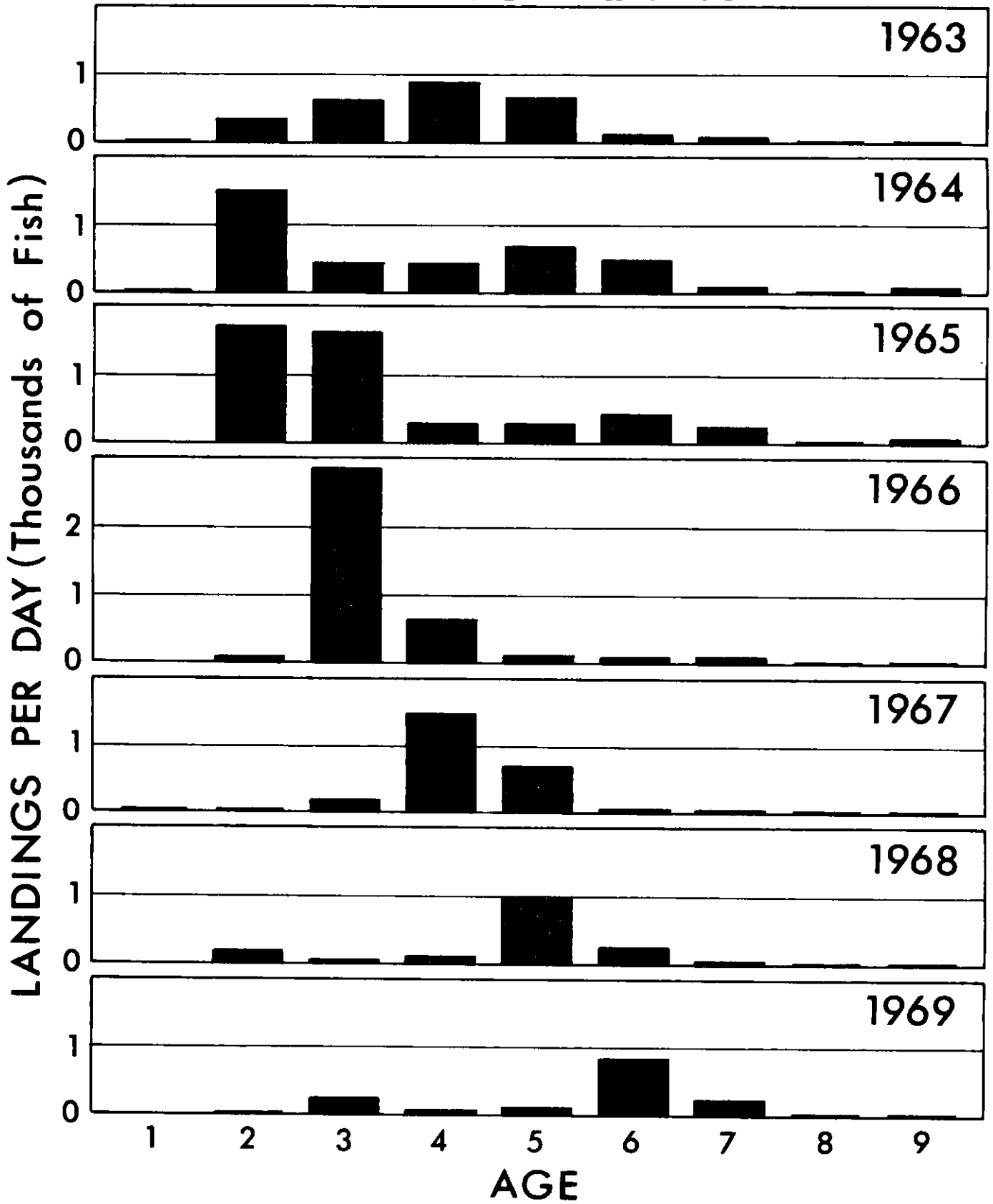


Fig. 1. Age composition of Georges Bank haddock