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STATUS OF NEW ENGLAND SEA-SCALLOP FISHERY^{1/}

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CONTENTS

	PAGE		PAGE
INTRODUCTION	2	SOUTHEAST GEORGES	7
UNITED STATES LANDINGS	2	SOUTHWEST GEORGES	7
COMPARISON BY REGIONS	3	NANTUCKET SHOALS	7
NEW BEDFORD LANDINGS AND FISHING AREAS: ..	4	OFF FIRE ISLAND INLET	7
STELLWAGEN OR MIDDLE BANK	6	ABUNDANCE	7
WESTERN SIDE OF SOUTH CHANNEL	6	THE FUTURE OF THE SCALLOP FISHERY	9
CULTIVATOR SHOALS	6	SUMMARY	16
NORTHERN EDGE	7	LITERATURE CITED	17



FIGURE 1 - TWO SCALLOPERS--REDSTART AND CHRISTINA J.--TIED UP AT A NEW BEDFORD DOCK GETTING READY FOR ANOTHER TRIP.

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^{1/} PREPARED AT THE REQUEST OF THE ATLANTIC STATES MARINE FISHERIES COMMISSION.

NOTE: ONLY THE SEA SCALLOP'S LARGE MUSCLE THAT CONTROLS THE SHELL MOVEMENTS IS MARKETED. SCALLOPS ARE SHUCKED AND THE LARGE MUSCLES (CALLED "EYES") CUT OUT ABOARD THE VESSEL, BUT THE REMAINDER IS GENERALLY DISCARDED. THEREFORE, THE SCALLOP MEATS LANDED REPRESENT ONLY A SMALL PROPORTION OF THE GROSS OR NET WEIGHT OF THE SCALLOPS.

INTRODUCTION

The giant or sea scallop, Pecten grandis (Solander),^{2/} is today one of New England's major fishery resources. The past two decades have witnessed about a tenfold rise in production--almost 20 million pounds of scallop meats, valued in excess of 9 million dollars, were landed in the peak year of 1950.



FIGURE 2 - A CLOSE-UP VIEW OF A TYPICAL NEW BEDFORD SCALLOP DRAGGER (MOONLIGHT) IN PORT.

The industry has in past years expressed concern for the future of the fishery. Although the over-all production trend has been upward, there has been a general belief among scallop fishermen that production was maintained at the expense of depletion of certain grounds and that the present rate of fishing would result in ultimate depletion of all areas. Fishermen have reported that in many areas they are forced to work longer to get a trip.

Recognizing the need for a more adequate knowledge of this fishery, the U. S. Fish and Wildlife Service in July 1943 instituted routine collection of data relative to the fishery at New Bedford, Mass., now the world's largest sea scallopport. Since that date, skippers of scallop draggers landing at the port of New Bedford have been interviewed by a representative of the Fish and Wildlife Service. The information obtained includes the sailing and landing date, grounds and depths fished, actual fishing time,^{3/} and quantity of scallop meats landed. From these basic data it is now possible to present a general picture of the activities of the scallop fleet as it has shifted from ground to ground and to obtain some information on the changing abundance of scallops in different areas during the past nine years.

Members of the scallop industry have asked that some regulation be applied to the fishery in order to insure maintenance of the high productivity which has characterized the operations over the past years. Before any recommendations for conservation measures can be made, two basic questions must be answered: (1) Are there signs of depletion on the scallop grounds? (2) How long can the grounds withstand present fishing intensity?

An answer to the first question can be given on the basis of the interview data collected over the past nine years. The second question cannot be fully answered until more is learned about the biology of the sea scallop.

UNITED STATES LANDINGS

In table 1 are tabulated the United States landings of sea scallops (meats only) by state and region for all years since 1889 for which records are available.

^{2/}THE CORRECT SCIENTIFIC NAME OF THE SEA SCALLOP HAS BEEN THE SUBJECT OF CONSIDERABLE DEBATE. MODERN TAXONOMISTS SEEM TO AGREE ON PECTEN GRANDIS (SOLANDER). OTHER NAMES FOUND IN LITERATURE ARE P. MAGELLANICUS (GMELIN) AND P. TENUICOSTATUS (MIGHELS).

^{3/}"DAYS FISHED" AS USED IN THIS REPORT INCLUDES TIME SPENT IN ACTUAL FISHING AND MOVEMENT FROM GROUND TO GROUND, BUT DOES NOT INCLUDE TIME SPENT "JOGGING" DURING ADVERSE WEATHER.

There are only sporadic records from 1889 to 1929. From 1929 to the present the records are fairly complete. The variations in U. S. landings from 1929 through 1952 are shown graphically in figure 3.

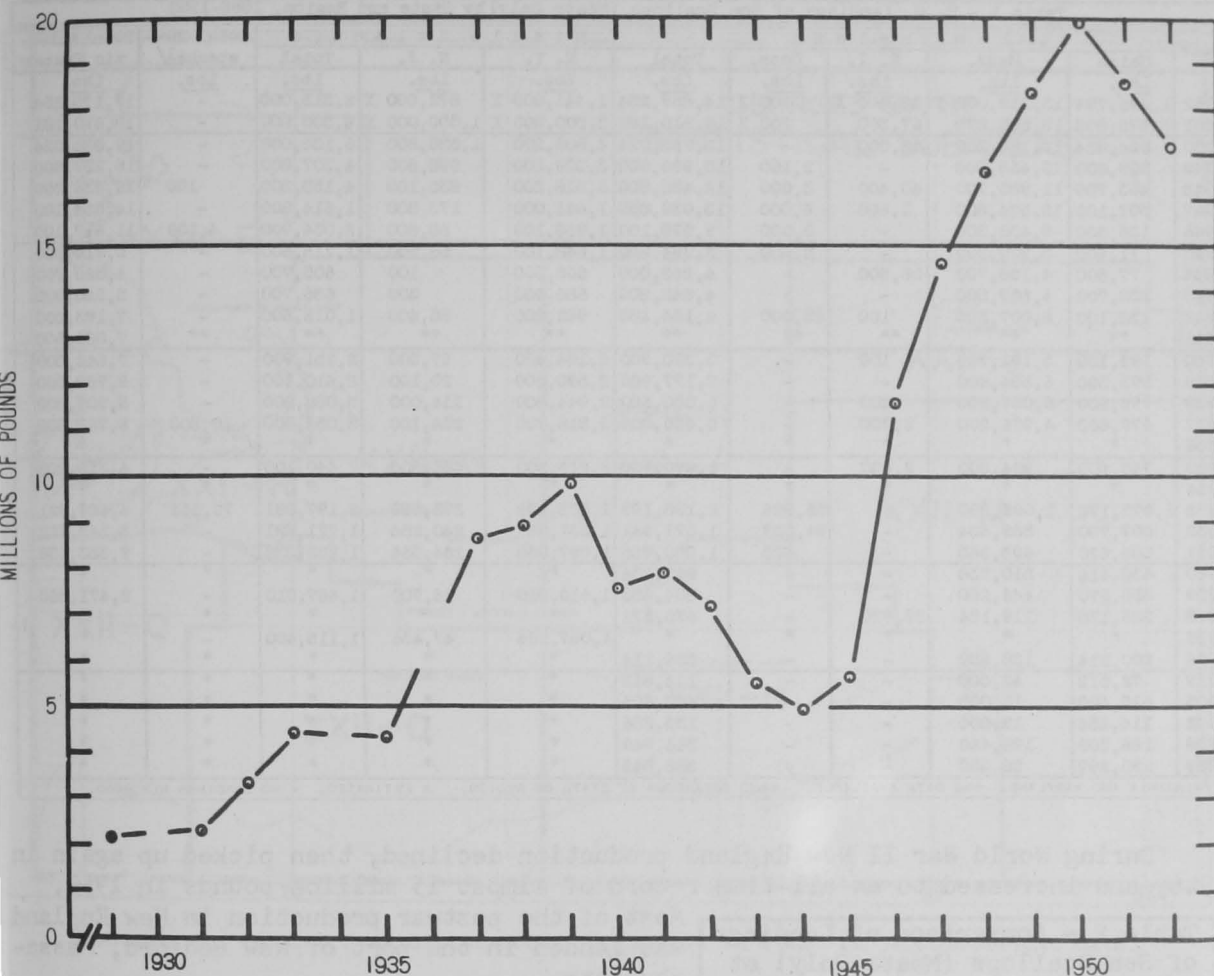


FIGURE 3 - TOTAL UNITED STATES LANDINGS OF SEA SCALLOPS (MEATS ONLY), 1929-52.

We note that landings rose from slightly over 2 million pounds of scallop meats in 1929 (the first year for which we have complete statistics) to almost 20 million pounds in 1950, reaching an initial peak of about 10 million pounds in 1939, dropping during World War II to slightly less than 5 million pounds in 1944, and then rising rapidly to the peak in 1950. Landings decreased in 1951, and in 1952 dropped to about 17 million pounds--the lowest since 1948.

COMPARISON BY REGIONS: In the early years of the fishery by far the greatest portion of the United States sea-scallop catch was landed in the New England States, but with the discovery of scallop beds off Long Island in the early 1920's, the Middle Atlantic ports assumed leadership. Many of the boats fishing the New England area (principally off the Maine coast) moved their base of operations. It was not until the middle 1930's that the New England landings again exceeded the Middle Atlantic catch. This was not due to a shift from Middle Atlantic ports because the landings in these ports also increased up to 1938.

The increased landings in New England were due to the discovery of scallop beds on Georges Bank and the development of markets for the product. Most of this catch was landed in Massachusetts ports. As indicated in table 1, Massachusetts

landings which had generally been well under one million pounds of scallop meats jumped to almost 5 million pounds in 1937.

Year	New England					Middle Atlantic				Total Chesapeake	Total Atlantic States
	Maine	Mass.	R. I.	Conn.	Total	N. Y.	N. J.	Total			
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
1952	1,495,754	13,319,000 X	42,400 X	100 X	14,857,254	1,441,000 X	872,000 X	2,313,000	-	17,170,254	
1951	676,803	13,565,878	67,300	200 X	14,310,181	3,300,000 X	1,000,000 X	4,300,000	-	18,610,181	
1950	524,824	13,186,200	42,000	-	13,753,024	4,806,200	1,328,800	6,135,000	-	19,888,024	
1949	509,000	13,468,900	-	2,100	13,980,000	3,309,200	998,600	4,307,800	-	18,287,800	
1948	453,700	11,985,700	40,400	3,000	12,482,800	3,318,200	835,100	4,153,300	100	16,636,200	
1947	507,100	12,524,600	1,600	6,000	13,039,300	1,441,000	173,800	1,614,800	-	14,654,100	
1946	136,800	9,438,300	-	3,000	9,578,100	1,966,100	68,800	2,034,900	4,100	11,617,100	
1945	71,400	3,920,200	-	2,600	3,994,200	1,648,100	68,500	1,716,600	-	5,710,800	
1944	77,800	4,158,700	26,500	-	4,263,000	605,600	100	605,700	-	4,868,700	
1943	232,700	4,609,500	-	-	4,842,200	686,400	300	686,700	-	5,528,900	
1942	132,100	6,007,200	100	25,000	6,164,400	962,200	56,400	1,018,600	-	7,183,000	
1941	**	**	**	**	**	**	**	**	**	7,864,500	
1940	199,100	5,191,700	100	-	5,390,900	2,184,400	67,500	2,251,900	-	7,642,800	
1939	593,500	6,584,400	-	-	7,177,900	2,590,500	20,100	2,610,600	-	9,788,500	
1938	792,900	5,057,200	400	-	5,850,500	2,944,800	114,000	3,058,800	-	8,909,300	
1937	679,400	4,976,900	2,700	-	5,659,000	2,818,700	234,100	3,052,800	10,800	8,722,600	
1936	*	*	*	*	*	*	*	*	*	*	
1935	743,200	924,300	2,600	-	1,670,100	2,213,500	426,600	2,640,100	-	4,310,200	
1934	*	*	*	*	*	*	*	*	*	*	
1933	1,073,172	1,029,097	-	55,926	2,158,195	1,823,492	373,589	2,197,081	72,645	4,427,921	
1932	607,780	869,634	-	94,527	1,571,941	1,531,587	240,234	1,771,821	-	3,343,762	
1931	586,870	493,663	-	423	1,080,956	1,097,868	154,364	1,252,232	-	2,333,188	
1930	436,416	510,738	-	-	947,154	*	*	*	*	*	
1929	358,570	446,280	-	-	804,850	1,610,310	56,700	1,667,010	-	2,471,860	
1928	326,178	119,124	29,970	-	475,272	*	*	*	*	*	
1926	*	*	*	*	*	1,067,964	47,436	1,115,400	-	*	
1924	200,514	138,600	-	-	339,114	*	*	*	*	*	
1919	72,512	42,300	-	-	114,812	*	*	*	*	*	
1905	415,600	15,005	-	-	430,605	*	*	*	*	*	
1902	114,656	19,200	-	-	133,856	*	*	*	*	*	
1898	166,509	198,440	-	-	364,949	*	*	*	*	*	
1889	295,299	28,550	-	-	323,849	*	*	*	*	*	

1/VIRGINIA AND MARYLAND. *NO DATA AVAILABLE. **NO BREAKDOWN BY STATE OR REGION. X ESTIMATED. - NO LANDINGS REPORTED.

During World War II New England production declined, then picked up again in 1946, and increased to an all-time record of almost 15 million pounds in 1952.

Table 2 - Comparison of Landings of Sea Scallops (Meats Only) at New Bedford, Mass., with Atlantic Coast States, 1938-52

Year	New Bedford	Atlantic Coast	Percentage landed at New Bedford
	(Thousands of Lbs.)		%
1952	12,110	17,170 X	70.5
1951	12,602	18,610 X	67.7
1950	11,982	19,888	60.2
1949	11,707	18,288	64.0
1948	10,082	16,636	60.6
1947	10,675	14,654	72.8
1946	8,940	11,617	77.0
1945	3,897	5,711	68.3
1944	4,009	4,869	82.3
1943	3,832	5,529	69.3
1942	5,446	7,183	75.8
1941	5,579	7,865	70.9
1940	4,414	7,643	57.8
1939	4,733	9,789	48.4
1938	4,255	8,909	47.8

X PARTIALLY ESTIMATED.

Most of the postwar production in New England was landed in the port of New Bedford, Massachusetts.

Middle Atlantic landings after the War rose to a peak of over 6 million pounds in 1950 and then declined to a little over 2 million pounds in 1952.

NEW BEDFORD LANDINGS AND FISHING AREAS

The principal scallop port for many years, especially since 1941, has been New Bedford. Landings at this port are compared with those for the entire Atlantic Coast for the years 1938 through 1952 in table 2. Most of the studies included in this report are based on an analysis of landings in New Bedford from 1944 through 1952, during which period New Bedford received from 60 to 82 percent of the total Atlantic Coast scallop production.

Scallops landed at New Bedford are taken largely from eight of the statistical subareas

established by the North American Council for Fishery Investigations as revised in 1943 (Rounsefell 1948)--fig. 4. Landings from each of these areas for the years 1944 through 1952 are given in table 3.

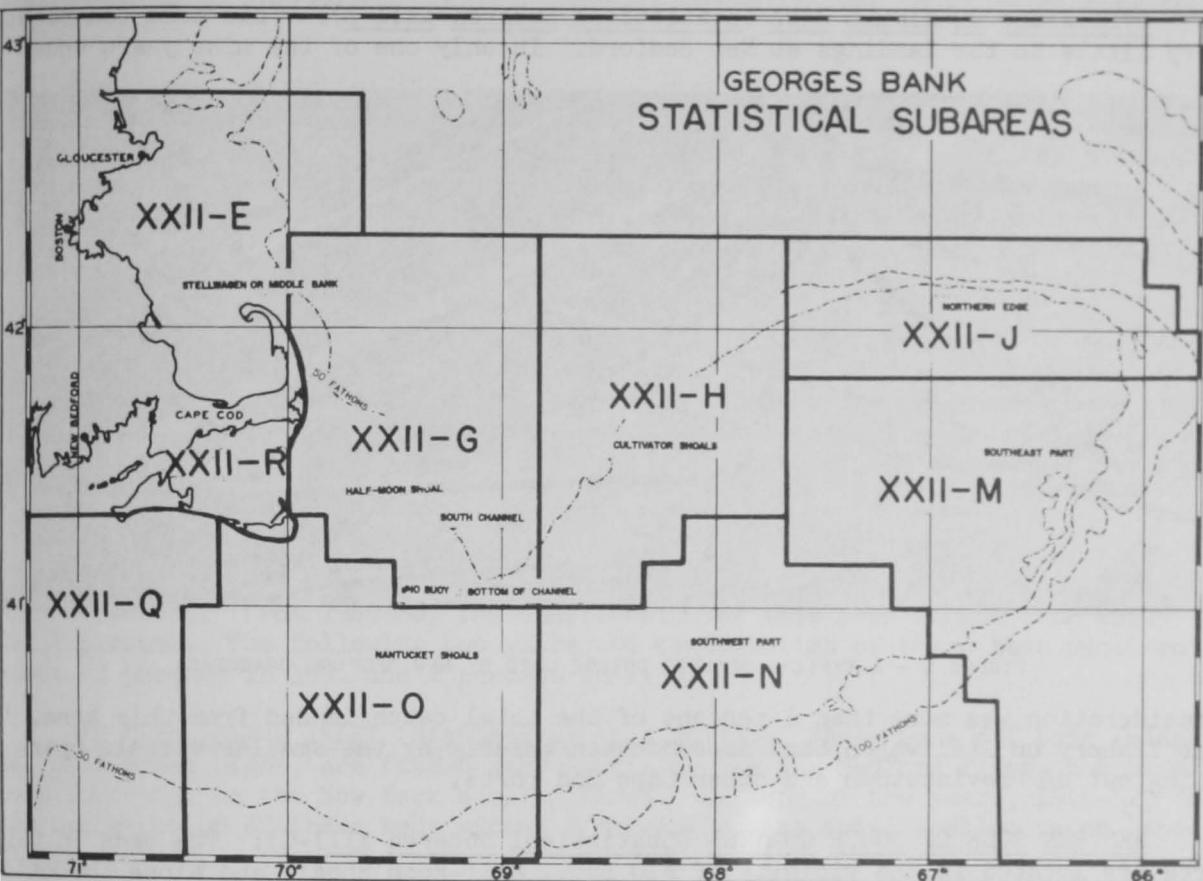


FIGURE 4 - REVISED STATISTICAL SUBAREAS ADOPTED IN 1943 FOR BIOSTATISTICAL DATA.

The fluctuations in the percentage contributions of the various areas to the New Bedford landings are not, of course, reliable indicators of depletion or abundance. The amount of fishing in any given area will be determined to some extent

Table 3 - New Bedford (Mass.) Landings of Sea Scallops (Meats) by Area of Catch, 1944-52

Year	Unit	Stellwagen or Middle Bank (XXII-E)	W. Side So. Channel (XXII-G)	Cultivator Shoals (XXII-H)	Northern Edge (XXII-J)	Southeast Georges (XXII-M)	Southeast Georges (XXII-N)	Nantucket Shoals (XXII-O)	Off Fire Island Inlet (XXIII)	Total All Areas
1952	Lbs.	12,109	2,773,095	36,329	5,049,698	3,172,712	823,452	242,192	-	12,109,567
	%	0.1	22.9	0.3	41.7	26.2	6.8	2.0	0.0	100.0
1951	Lbs.	126,023	1,764,319	819,148	3,516,035	1,109,000	3,730,273	1,499,671	37,807	12,602,276
	%	1.0	14.0	6.5	27.9	8.8	29.6	11.9	0.3	100.0
1950	Lbs.	203,697	2,048,955	59,910	2,180,758	2,024,989	2,743,920	2,552,205	167,751	11,982,185
	%	1.7	17.1	0.5	18.2	16.9	22.9	21.3	1.4	100.0
1949	Lbs.	81,950	2,411,676	468,286	4,237,994	152,193	468,287	3,816,536	70,243	11,707,165
	%	0.7	20.6	4.0	36.2	1.3	4.0	32.6	0.6	100.0
1948	Lbs.	30,246	1,492,107	141,145	3,770,595	2,278,488	90,736	2,086,934	191,554	10,081,805
	%	0.3	14.8	1.4	37.4	22.6	0.9	20.7	1.9	100.0
1947	Lbs.	85,400	1,366,414	1,195,612	7,525,950	96,076	-	394,979	10,675	10,675,106
	%	0.8	12.8	11.2	70.5	0.9	0.0	3.7	0.1	100.0
1946	Lbs.	44,700	563,221	992,342	4,085,588	143,040	2,369,104	742,021	-	8,940,016
	%	0.5	6.3	11.1	45.7	1.6	26.5	8.3	0.0	100.0
1945	Lbs.	-	331,230	701,430	1,987,385	136,390	116,905	545,557	77,936	3,896,833
	%	0.0	8.5	18.0	51.0	3.5	3.0	14.0	2.0	100.0
1944	Lbs.	40,088	240,529	400,881	2,325,111	400,881	120,265	481,057	-	4,008,812
	%	1.0	6.0	10.0	58.0	10.0	3.0	12.0	0.0	100.0

by the relative productivity of adjacent areas. It is, therefore, possible that a productive area may be neglected for some period of time if neighboring areas are found to be more profitably fished.

STELLWAGEN OR MIDDLE BANK (Statistical Subarea XXII-E): This area contributes very little to the landings at New Bedford. In only one of the nine years under

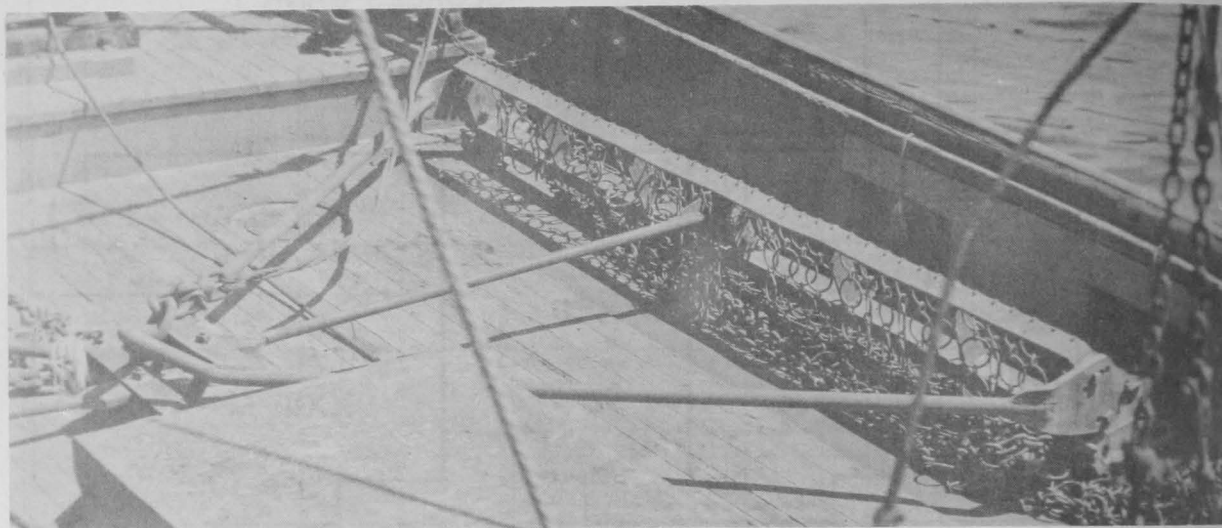


FIGURE 5 - A TYPICAL SCALLOP DREDGE USED BY NEW BEDFORD DRAGGERS.

consideration was more than 1 percent of the total catch landed from this area. The fishery on Stellwagen Bank is conducted chiefly by the smaller vessels operating out of Provincetown and other Cape Cod ports.

WESTERN SIDE OF SOUTH CHANNEL (Statistical Subarea XXII-G): The beds in this area are located in the vicinity of #10 Buoy, Half-Moon Shoal, and along the Bottom of South Channel. In 1944, 6 percent of the total catch came from this area. In subsequent years, the contribution of this area increased, until more than 20 percent of the total came from here in 1949. The production from this area decreased slightly in 1950 and 1951, and then increased again in 1952, with almost 23 percent of the catch originating here in that year.

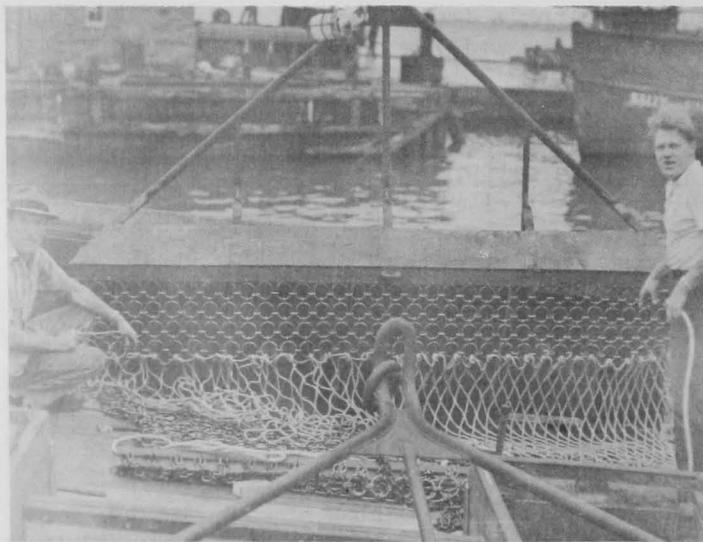


FIGURE 6 - THE DRAGGER ARNOLD BEING FITTED WITH A NEW SCALLOP DREDGE AT A NEW BEDFORD SHIPYARD.

CULTIVATOR SHOALS (Statistical Subarea XXII-H): This ground contributed 10 percent of the catch in 1944, 18 percent in 1945, and about 11 percent in each of the next two years. Subsequent years saw only minor landings from this area. An increase was noted in 1951, when more than 6 percent of the total catch came from this area, but in 1952 the catch from this ground dropped again.

NORTHERN EDGE (Statistical Subarea XXII-J): In the earlier years, 1944-47, this was the most important scallop area, accounting for 45 to 70 percent of the catch. In each of the next two years, 1948 and 1949, this area contributed between 36 and 37 percent of the catch, and in 1950 about 18 percent. During the next two years production increased. In 1952 over 40 percent of the total catch came from here.

SOUTHEAST GEORGES (Statistical Subarea XXII-M): These beds accounted for 10 percent of the total catch in 1944, but in subsequent years a considerable decline in landings was noted, until 1947 when less than 1 percent of the total catch came from here. In 1948 there was a tremendous increase, with almost 23 percent of the total catch coming from these beds. In following years the landings from this area varied greatly, declining to about 1 percent in 1949 and jumping to over 26 percent of the New Bedford landings in 1952.

SOUTHWEST GEORGES (Statistical Subarea XXII-N): Only 3 percent of the catch was landed from this area in 1944 and 1945, but in 1946 more than 26 percent of the total originated here. The next two years landings from this area were practically nil. In 1949, 4 percent came from this area, and in 1950 and 1951, 23 and 30 percent, respectively. In 1952 less than 7 percent of the New Bedford catch originated here.

NANTUCKET SHOALS (Statistical Subarea XXII-O): During 1944-46, the contribution of this area fluctuated between 8 and 14 percent. In 1947 it dropped to less than 4 percent. From 1948-50, the contribution of this area ranged from about 21 to 33 percent. The following two years the contribution of these beds declined to about 12 percent in 1951 and 2 percent in 1952.

OFF FIRE ISLAND INLET (Statistical Area XXIII): These beds off Long Island, SE. of Ambrose Light, are fished very little by the New Bedford fleet, but have been important to the New York scallop fleet. In none of the years, 1944-52, does the contribution of these beds exceed 2 percent of the total scallop catch landed at New Bedford.

ABUNDANCE

Landings alone do not tell us much about the relative abundance of scallops on the grounds. Landings have been artificially controlled by agreements among the fishermen. The union has prescribed a catch limit of 100 gallons (900 pounds) of scallop meats per man per trip during most of the period of this study. In the early part of the period the limit was 150 gallons (1,350 pounds). The union rules

Table 4 - Abundance Index (Catch Per-Unit-Of-Effort) for the New Bedford Sea-Scallop Fleet, 1944-52^{1/}

Year	Quantity Hailed (Meats)	Trips	Days Fished	Avg. No. of Days Fished Per Trip	Catch Per Boat Per Day (Meats)
	Lbs.			No.	No.
1952	12,149,200	1,393	7,792.6	5.6	1,559
1951	12,496,346	1,478	7,537.0	5.1	1,658
1950	11,587,329	1,393	7,040.0	5.1	1,646
1949	11,214,468	1,494	8,072.8	5.4	1,389
1948	9,510,732	1,404	7,205.1	5.1	1,320
1947	10,519,335	1,435	6,301.0	4.4	1,669
1946	7,586,775	766	4,238.0	5.5	1,790
1945	2,813,544	296	1,717.2	5.8	1,638
1944	3,093,462	325	1,711.6	5.3	1,807

^{1/} INTERVIEWED VESSELS ONLY.

further required that boats engage in actual fishing operations for not more than 8 days and that they remain in port 2 to 4 days between trips. However, these regulations have not been in force since the latter part of 1952.

Throughout the period of this study the scallop boats were able to catch the established limit in less than eight days, except during periods of unfavorable weather. We are thus afforded two measures of abundance: the catch per-unit-of-effort and the number of fishing days required to catch the prescribed limit.

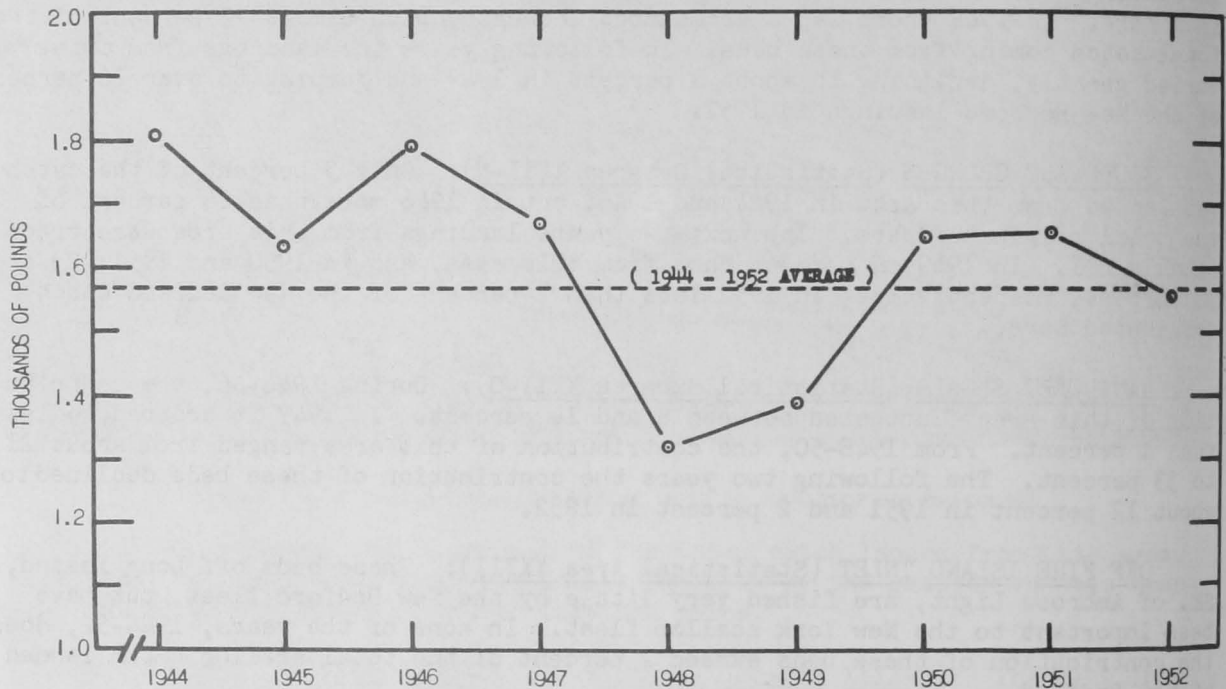


FIGURE 7 - CATCH PER BOAT PER DAY (IN THOUSANDS OF POUNDS) FOR THE NEW BEDFORD SEA-SCALLOP FLEET, 1944-52.

The first index, catch per boat per day, is shown in the last column of table 4 and is plotted in fig. 7. It will be noted that this index varies very little throughout the period of study except for the years 1948 and 1949 when the index was somewhat lower.

The other index, average number of days fished per trip, was also remarkably uniform (column 5, table 4).

One must conclude from these data that there has not been a serious depletion of scallops in the Atlantic banks considering the area as a whole. It must be borne in mind that these figures are for landings at New Bedford regardless of area fished.

Since the fleet shifts its effort from place to place in order to continue operations in the best fishing areas it is desirable to examine abundance indexes according to particular regions.

In table 5 are tabulated the catches per day for statistical subareas from 1944 through 1952. The outstanding feature of this table is the uniformity of catch per day throughout the various areas and years. Most catches are between 1,200 and 1,800 pounds per day. In only two areas did the catch per day drop below 1,000

pounds during the nine-year period--Stellwagen Bank for three years and off Fire Island Inlet in 1947, but these areas were never important to the New Bedford fleet. Neither area contributed as much as 2 percent of the catch during the study period.

One possibly significant fact emerges from the data in this table. The two years, 1948 and 1949, which were low years in the index calculated for all banks,

Table 5 - Catch Per Day of Sea Scallops (Meats) by Area, 1944-52

Fishing Area	1952	1951	1950	1949	1948	1947	1946	1945	1944
 (Pounds)								
Stellwagen or Middle Bank (XXII-E)	820	1,231	1,286	1,021	906	945	1,102	1/	1,022
W. Side South Channel (XXII-G)	1,484	1,518	1,456	1,350	1,229	1,436	1,365	1,570	1,768
Cultivator Shoals (XXII-H) ..	1,505	1,680	1,463	1,525	1,336	1,642	1,677	1,624	1,609
Northern Edge (XXII-J)	1,577	1,714	1,606	1,364	1,307	1,734	1,870	1,698	1,886
Southeast Georges (XXII-M) ..	1,633	1,802	1,658	1,411	1,392	1,626	1,782	1,727	1,942
Southwest Georges (XXII-N) ..	1,502	1,623	1,766	1,323	1,260	1/	1,990	1,633	2,054
Nantucket Shoals (XXII-O) ...	1,474	1,764	1,806	1,456	1,389	1,794	1,505	1,456	1,596
Off Fire Island Inlet (XXIII)	1/	1,081	1,319	1,026	1,035	450	1/	1,080	1/

1/INSUFFICIENT FISHING TO COMPUTE A RELIABLE INDEX.

are years in which the index is generally low for each area. It might possibly mean that factors which control the abundance of scallops in one particular area have similar effects throughout the entire area of Georges Bank and Nantucket Shoals.

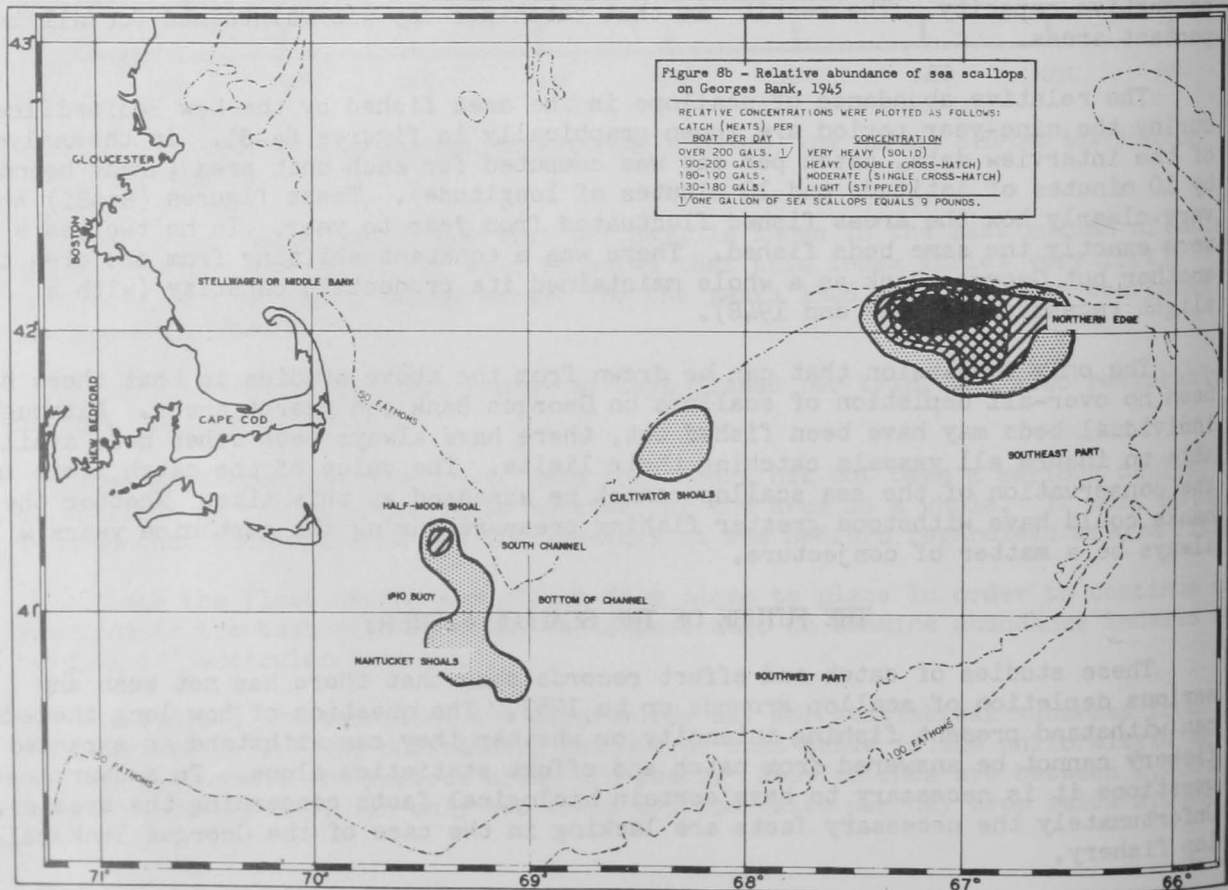
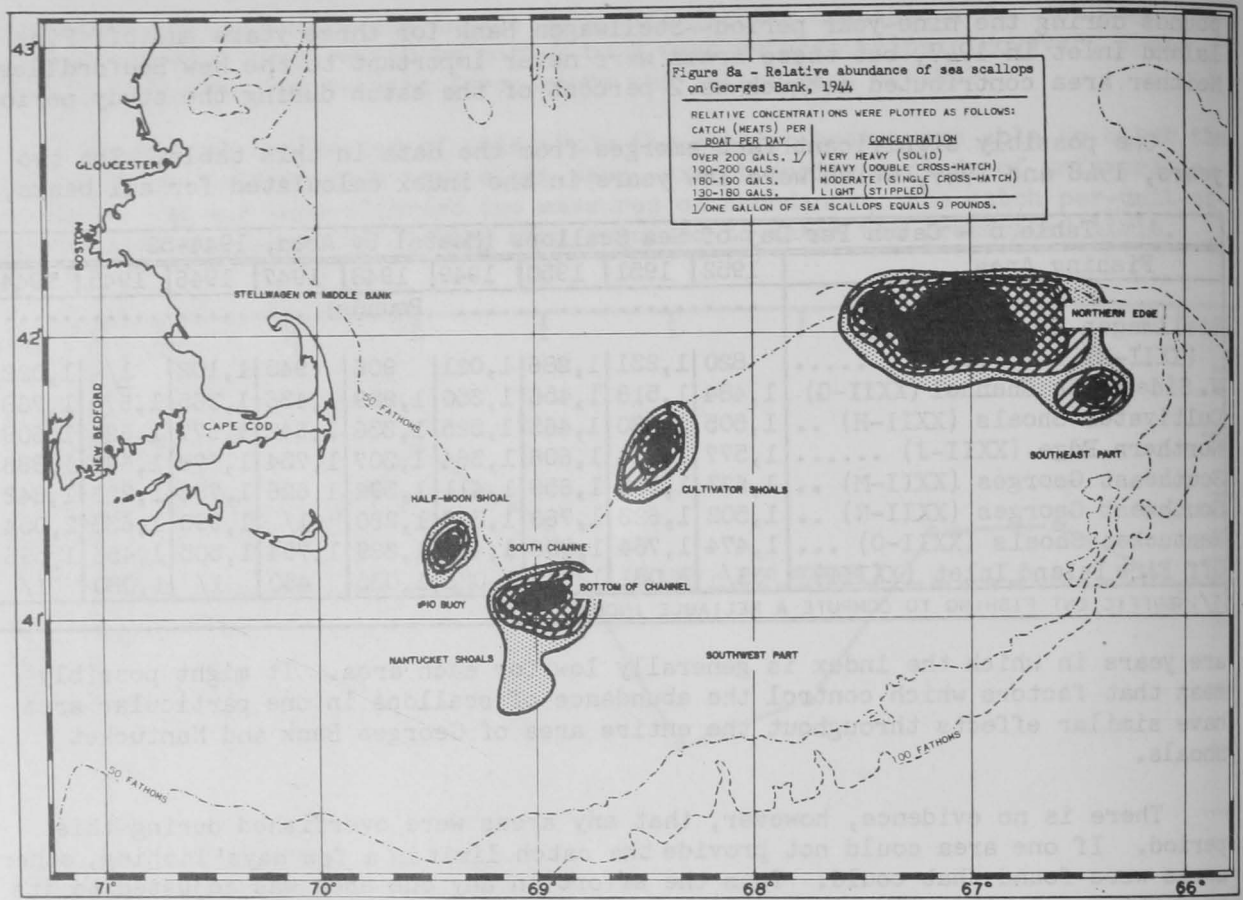
There is no evidence, however, that any areas were overfished during this period. If one area could not provide the catch limit in a few days' fishing, other areas were found that could. Thus the effort in any one area was adjusted to its productive capacity. The result is that catch-per-day was maintained for all important areas.

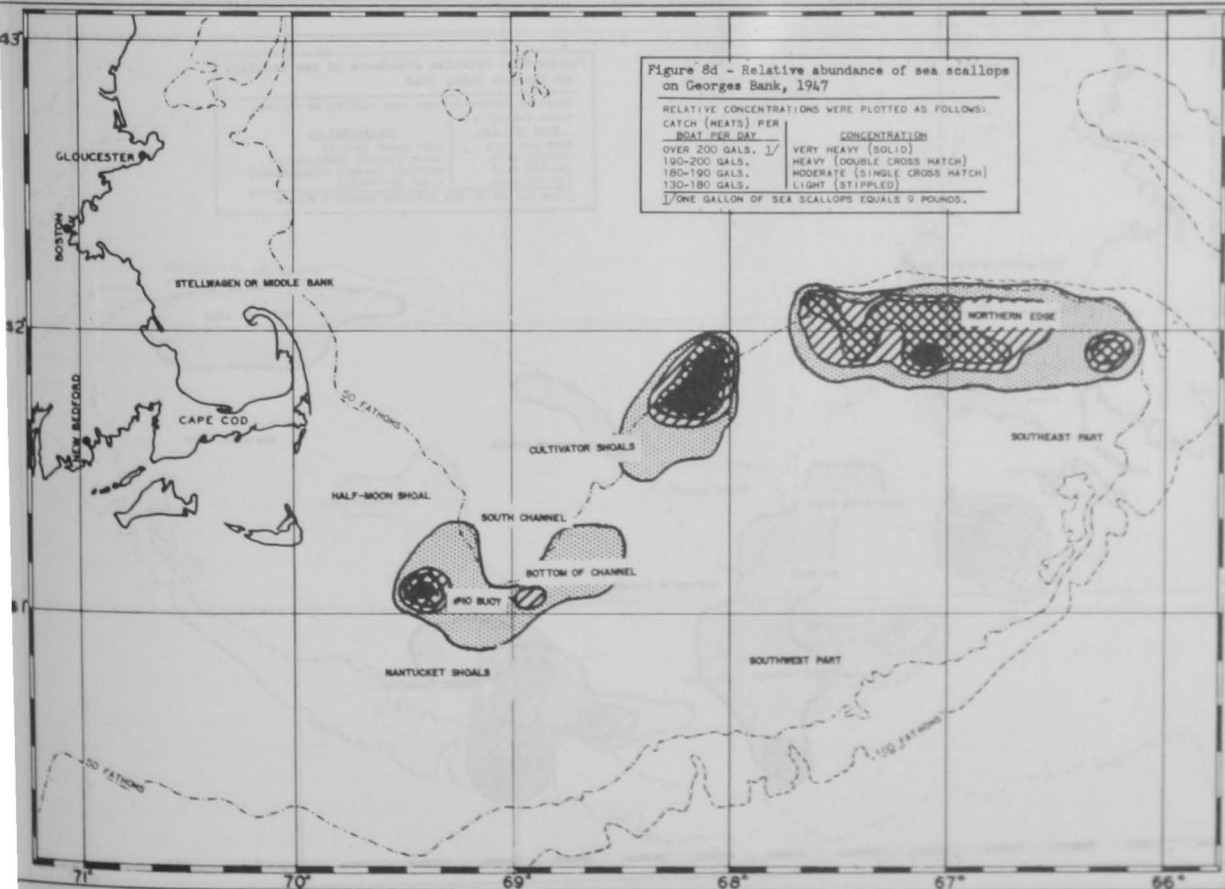
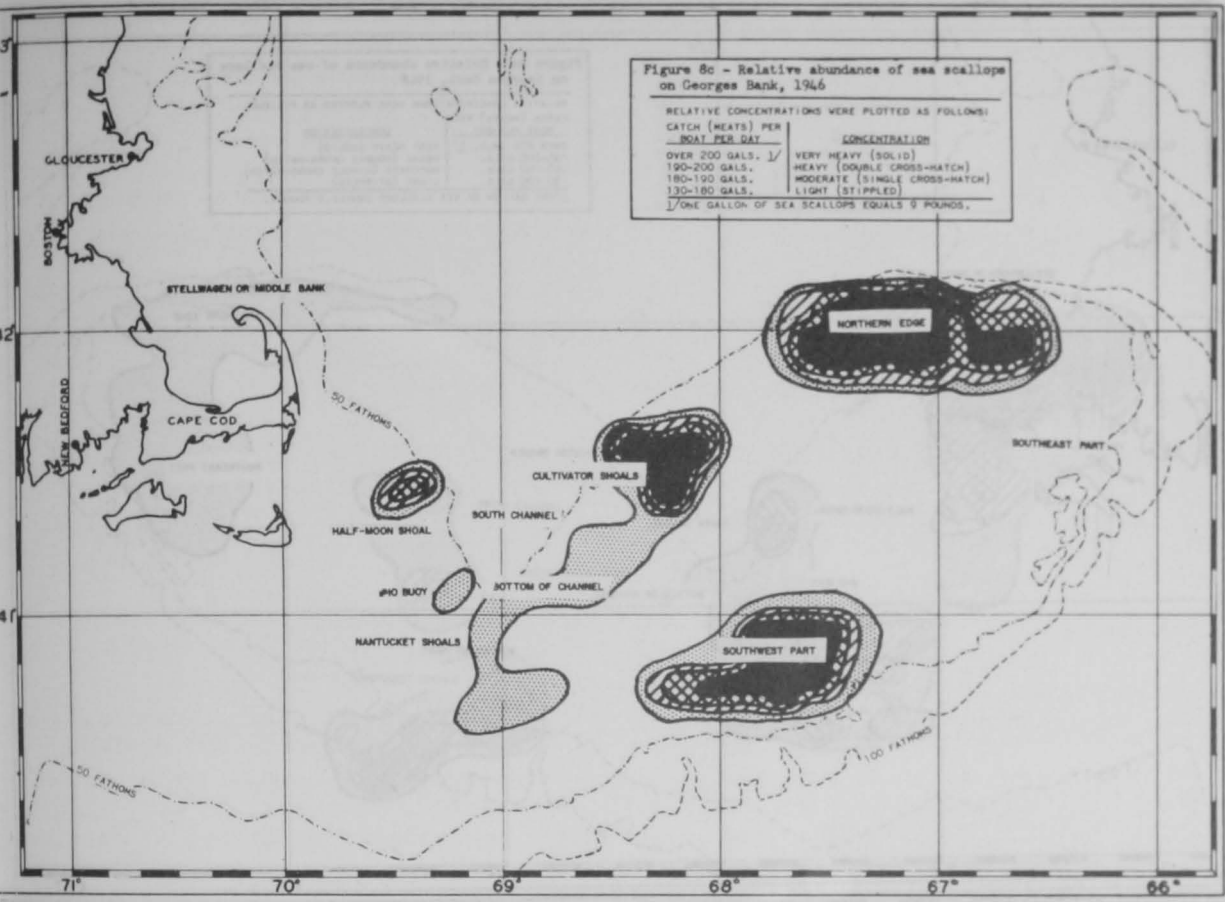
The relative abundance of scallops in the area fished by the New Bedford fleet during the nine-year period are shown graphically in figures 8a-8i. In the analysis of the interview data, catch per day was computed for each unit area (areas bounded by 10 minutes of latitude and 10 minutes of longitude). These figures (8a-8i) show very clearly how the areas fished fluctuated from year to year. In no two years were exactly the same beds fished. There was a constant shifting from one area to another but Georges Bank as a whole maintained its productive capacity (with a slight recession in 1947 and 1948).

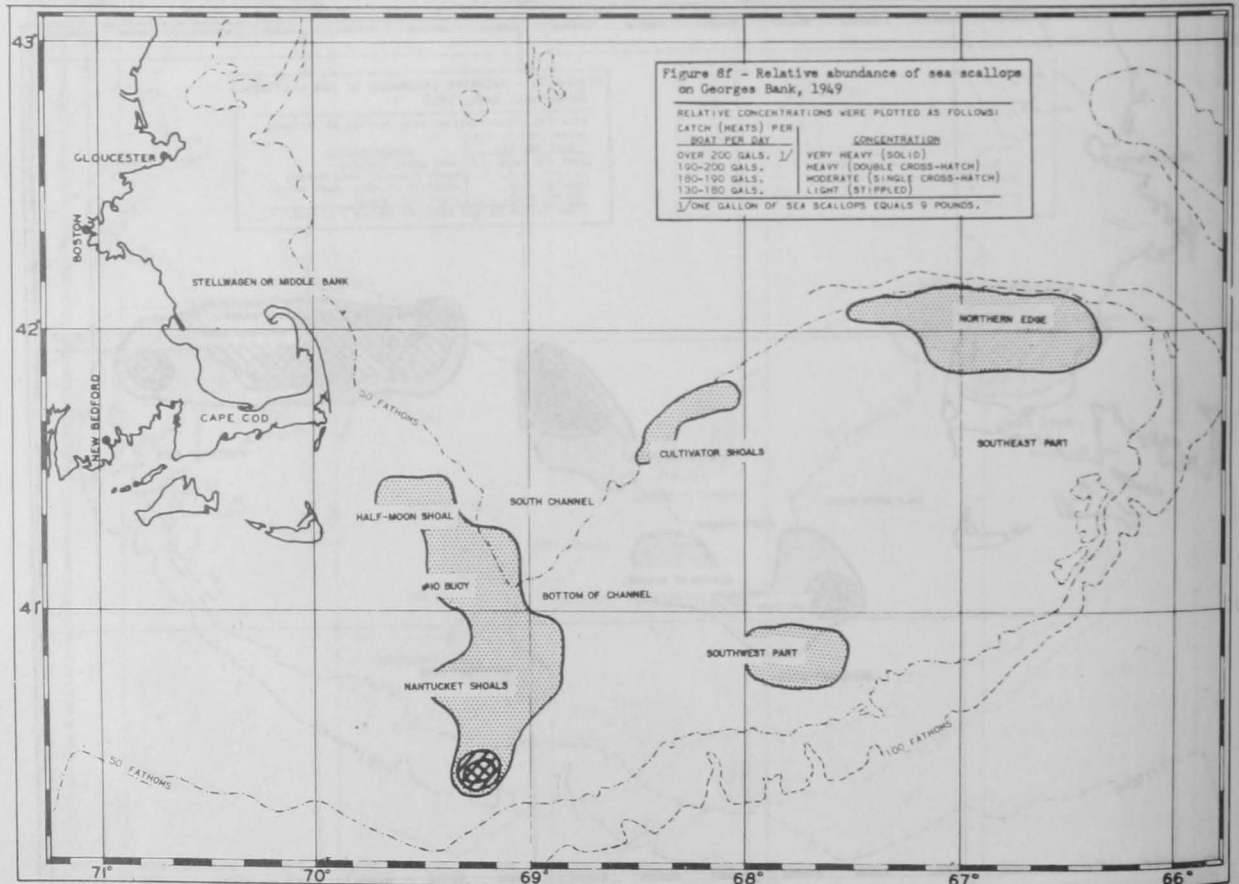
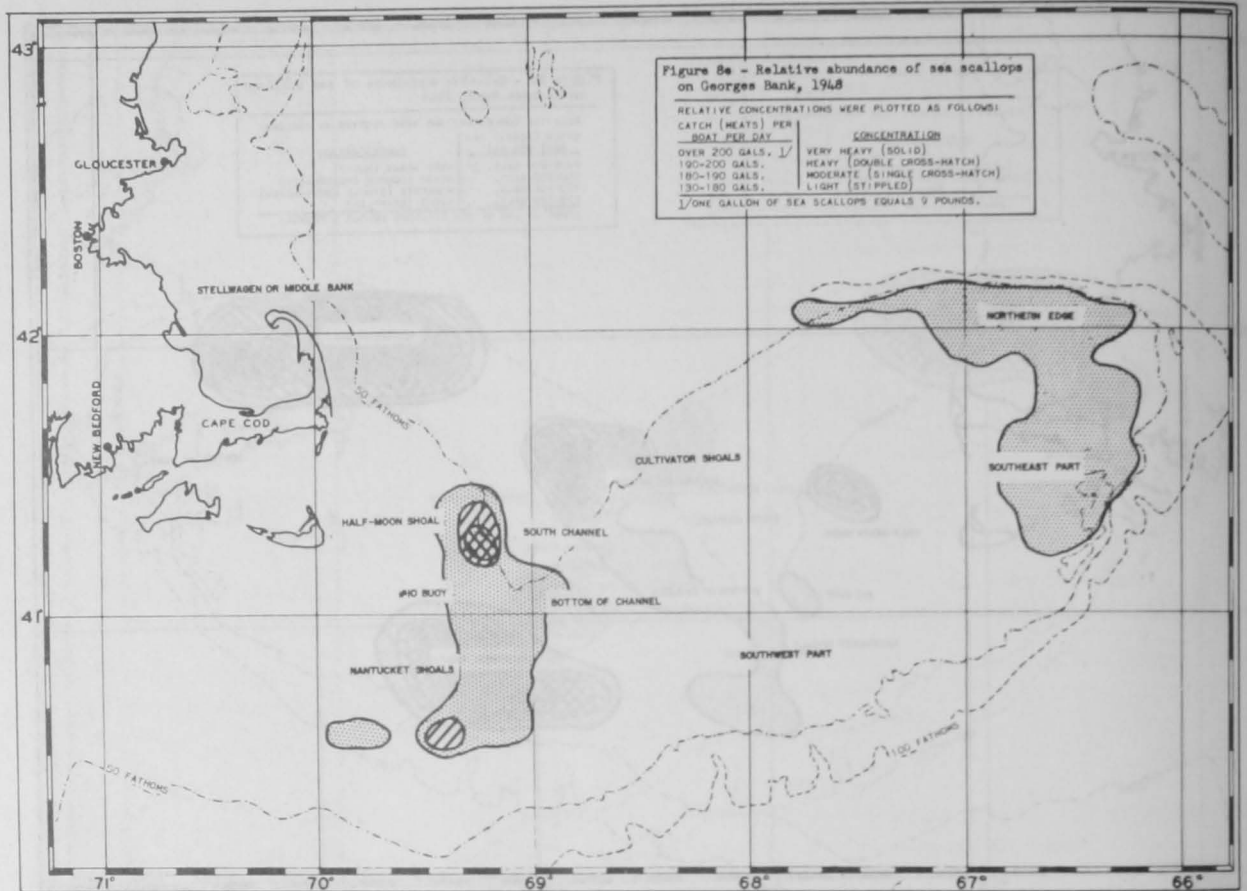
The only conclusion that can be drawn from the above studies is that there has been no over-all depletion of scallops on Georges Bank and nearby areas. Although individual beds may have been fished out, there have always been other beds available to insure all vessels catching their limits. The value of the catch limit in the conservation of the sea scallop cannot be assessed at this time. Whether the banks could have withstood greater fishing pressure during the past nine years will always be a matter of conjecture.

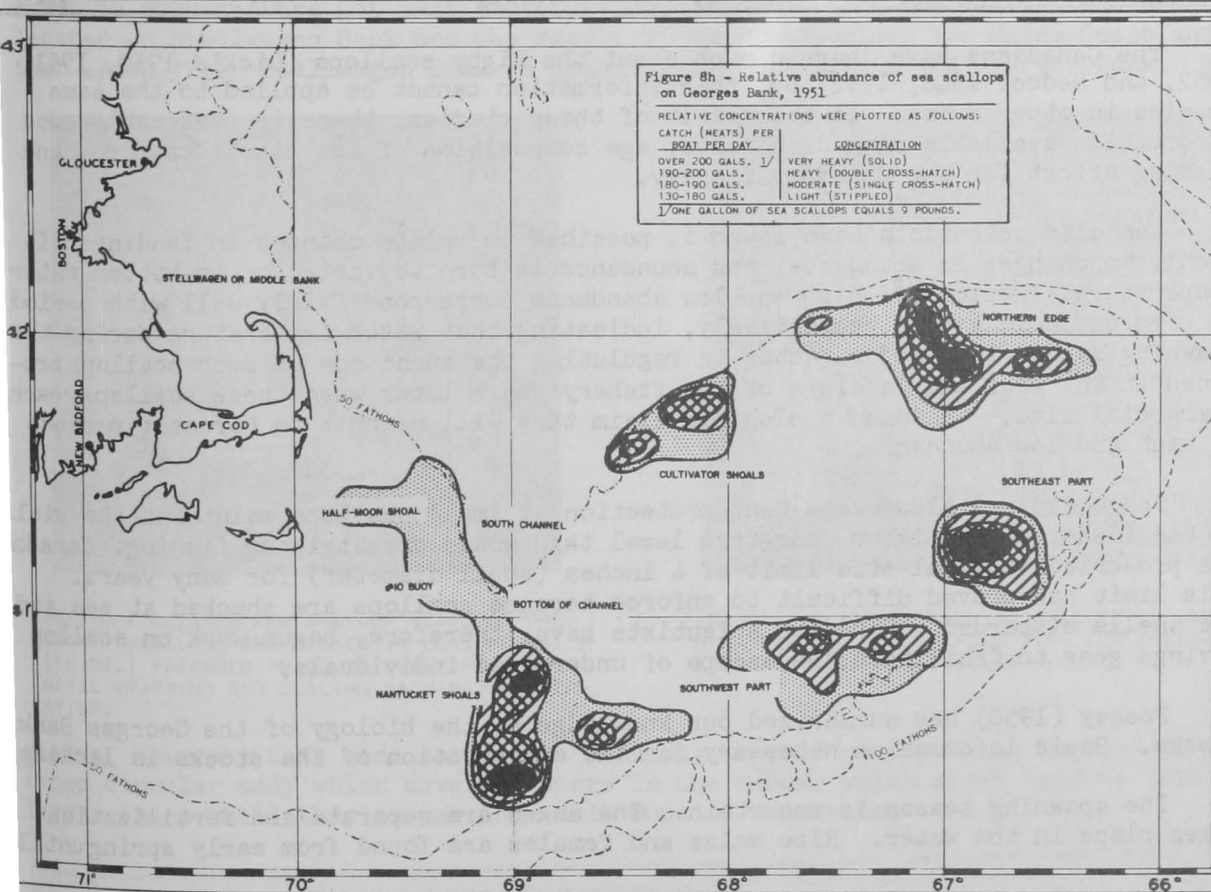
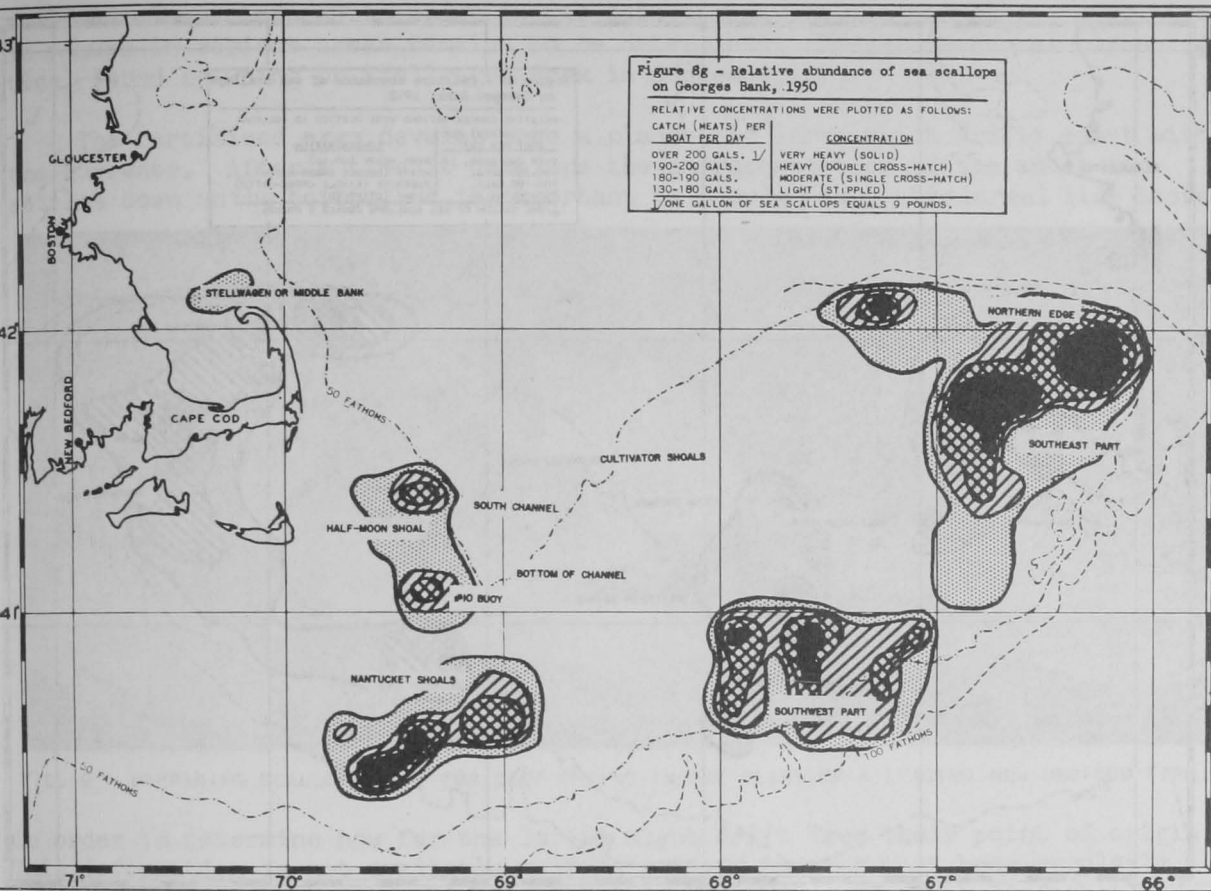
THE FUTURE OF THE SCALLOP FISHERY

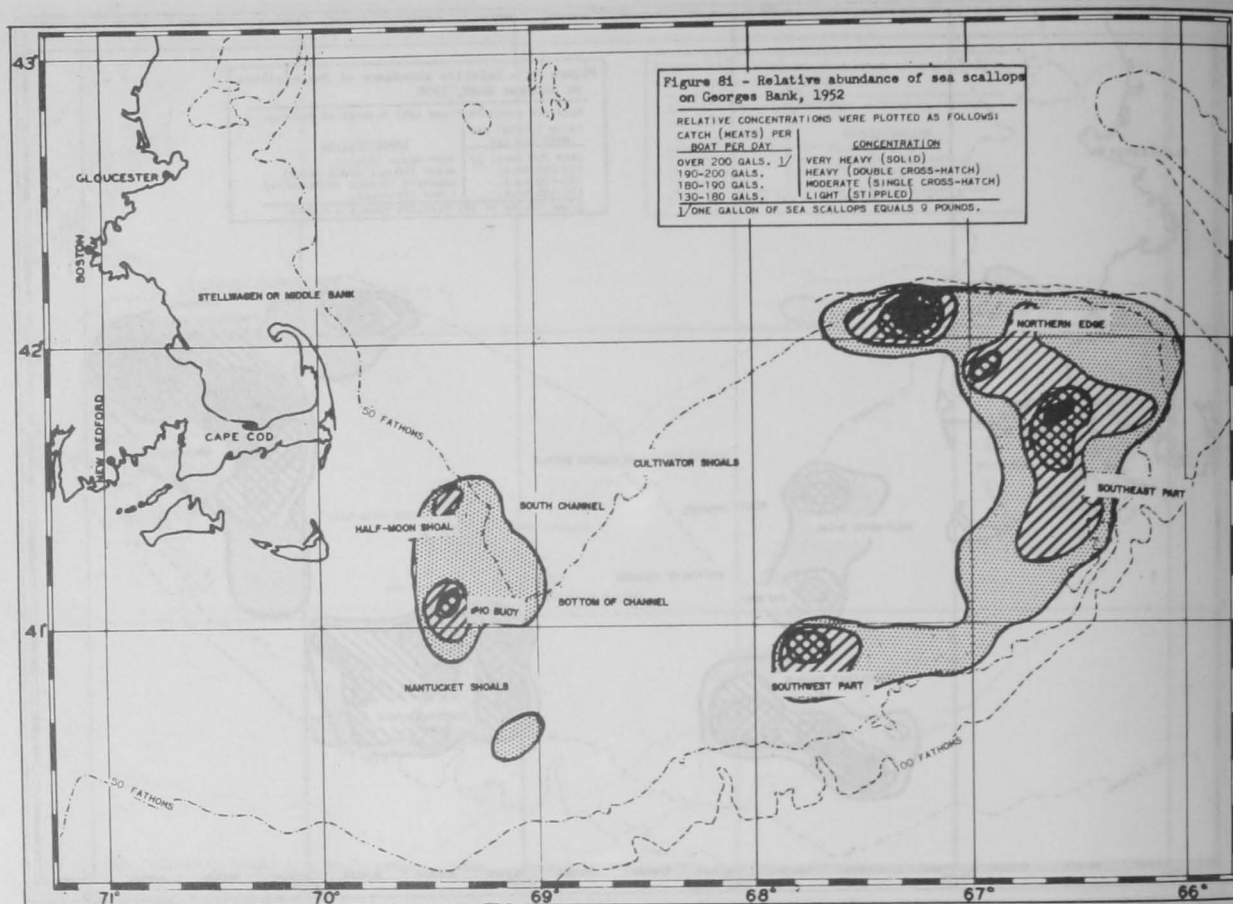
These studies of catch and effort records show that there has not been any serious depletion of scallop grounds up to 1953. The question of how long the beds can withstand present fishing intensity or whether they can withstand an expanded fishery cannot be answered from catch and effort statistics alone. To answer these questions it is necessary to have certain biological facts concerning the species. Unfortunately the necessary facts are lacking in the case of the Georges Bank scallop fishery.











The Canadians have learned much about the Digby scallops (Dickie 1950, 1951, 1952, and Medcof 1948, 1952) but this information cannot be applied to the same species in other areas. As the result of these studies, there is reasonably good information available on growth rates, age composition of the stock, catches, and fishing effort for the Canadian fishery.

Canadian scientists have found it possible to relate changes in landings directly to changes in abundance, and abundance in turn to variation in bottom water temperature. Periods of high and low abundance correspond fairly well with periods of warm and cold water, respectively, indicating that water temperature during the spawning season is a major factor in regulating the abundance of seed scallops produced in any year and landings of the fishery years later when these scallops reach commercial size. Canadian biologists claim they will be able to forecast periods of high and low abundance.

The Canadians also claim that protection of small scallops maintains the yield of the fishery at a higher long-term level than would unrestricted fishing. Canada has prescribed a legal size limit of 4 inches (shell diameter) for many years. This limit has proved difficult to enforce because scallops are shucked at sea and the shells discarded. Canadian scientists have, therefore, begun work on scallop savings gear to facilitate the escape of undersized individuals.

Posgay (1950) has summarized our knowledge of the biology of the Georges Bank stocks. Basic information necessary for the conservation of the stocks is lacking.

The spawning season is uncertain. The sexes are separate and fertilization takes place in the water. Ripe males and females are found from early spring until

fall and can be induced to spawn in the laboratory, but the normal spawning time in nature in various areas remains to be determined. Posgay (personal communication) found spawning on Stellwagen Bank in September.

The fertilized eggs develop into a planktonic larva which drifts about with the currents. After a time it develops the characteristics of the adult and settles down on the bottom. It is important to know how long this larval life lasts



FIG. 9 - PREPARING SCALLOP MEATS FOR DEEP FRYING IN THE PLANT OF A LEADING NEW BEDFORD FIRM.

in order to determine how far the larvae might drift from their point of origin. This information is not available. It is certain however that beds regularly swept by currents are not self perpetuating. Posgay is of the belief that beds located on Stellwagen Bank are the result of spawnings along the Maine Coast and that spawn from Stellwagen Bank is probably carried out toward Georges Bank. He



FIG. 10 - CLEANED RAW SCALLOP MEATS OR PRE-COOKED SCALLOPS ARE PACKED IN CONSUMER-SIZE (10 OZ.) PACKAGES PRIOR TO FREEZING. AUTOMATIC WRAPPING AND SEALING MACHINE IN OPERATION.



FIG. 11 - PLATE-TYPE QUICK FREEZER IS USED BY A LEADING NEW BEDFORD FIRM FOR FREEZING CONSUMER PACKAGED SCALLOP MEATS.

states, however, that beds on Georges Bank may be self perpetuating because of a large circular eddy which develops there in the summer which might tend to hold the larvae there until they assume the adult mode of existence.

The age and growth of Georges Bank scallops are imperfectly known. The concentric rings which in some molluscs (including the sea scallop in Canada) reveal the annual growth have in our sea scallops never been satisfactorily interpreted in relation to age. An alternative method of determining growth is by repeated examination and measurement of samples taken from the same population. This method might be used in the case of scallops, but would require the use of a research vessel for repeated samplings seasonally for several years.

Posgay is of the opinion that our sea scallop grows to a length of about 40 mm. ($1\frac{1}{2}$ inches) in the first year, 80 mm. ($3\frac{1}{8}$ inches) in the second year, 110 mm. ($4\frac{1}{3}$ inches) the third year, and thereafter grows more slowly. His estimates, however, are based on very sketchy evidence. We do not yet have sufficient information on growth to hazard an opinion on how long it would take a new set to reach commercial size.

Conversely, we do not know the natural mortality rates of these shellfish. Should they be fished as soon as they are of marketable size or would it pay to leave them to grow a little larger? Without this information we cannot recommend management procedures.

The importance of motility in scallops has always been of interest. Scallops can swim quite actively by clapping their shells together. The young appear to be more active than older individuals. The scallop beds seem to be on rather loose sand, in depressions in a level surface, on the edge of a shoal, or where a sloping surface becomes steeper (Posgay 1950). Whether sea scallops actively seek such places or are concentrated there by currents is not known.

There is a belief among some fishermen that scallops have a tendency to congregate and that beds will recover if left undisturbed for a period of time. A closed season is sometimes advocated on this basis but there is no experimental evidence to substantiate this opinion. We cannot at this time predict the effect of a cessation of fishing.

An extensive tagging program might shed some light on problems of growth and migration. No large-scale project has been undertaken, although Baird (1952) tagged 2,000 scallops in the past two years and has had some returns. His results are not available. Members of the Fish and Wildlife Service tagged 198 specimens on Southwest Georges in 1949 and 200 in 1950. Only one tag has been recovered to date. The tagged specimen was taken near its release point about 2 years after tagging. It had grown $\frac{3}{4}$ -inch.

SUMMARY

United States landings of sea scallops (meats) increased from about 2 million pounds in 1929 to about 20 million pounds in 1950, and then decreased to about 17 million pounds in 1952.

Most of the postwar production of sea scallops has been landed at the port of New Bedford, Mass. An analysis of catch and effort data collected at this port from 1944 to 1952 reveals that there was no serious depletion of scallops on Georges Bank and nearby areas during that period.

The future of the scallop fishery is uncertain. The biology of the scallops fished by United States vessels is too imperfectly known to form the basis of any predictions of the effects of different intensities of fishing.

LITERATURE CITED

- BAIRD, F.
1952. SCALLOP TAGGING PROGRAM IN MAINE AIMED AT INCREASING YIELD. ATLANTIC FISHERMAN, VOL. XXXIII, NO. 4 (APRIL 1952), P. 16.
- BELDING, D. L.
1910. THE SCALLOP FISHERY OF MASSACHUSETTS. THE COMMONWEALTH OF MASSACHUSETTS, 155 PP., 118 FIGS.
- DICKIE, L. M.
1950. ABUNDANCE CHANGES IN DIGBY SCALLOPS. FISH. RES. BD. CAN. PROG. REPT. OF THE ATL. CST. STAS., NO. 49 (APR. 1950), P. 14-17.
1952. CHANGES IN DIGBY SCALLOP LANDINGS - HOW AND WHY. FISH. RES. BD. OF CAN., PROG. REP. OF THE ATL. CST. STAS., NO. 54 (SEPT. 1952), PP. 12-18.
1951. BOUGHTON ISLAND, P.E.I., SCALLOP INVESTIGATION 1946. FISHERIES RESEARCH BOARD OF CANADA, MANUSCRIPT REPORTS OF THE BIOL. STA., NO. 415.
- DREW, G. A.
1906. THE HABITS, ANATOMY, AND EMBRYOLOGY OF THE GIANT SCALLOP (PECTEN TENUICOSTATUS, MIGHELS). UNIV. OF MAINE STUDIES, NO. 6, 71 PP., 36 FIGS.
- MEDCOF, J. C.
1949. MEAT YIELD FROM DIGBY SCALLOPS OF DIFFERENT SIZES. FISH. RES. BD. OF CAN., PROG. REPTS. OF THE ATL. BIOL. STAS., NO. 44 (JAN. 1949), PP. 6-9.
1949. DARK-MEAT AND THE SHELL DISEASE OF SCALLOPS. FISH. RES. BD. OF CAN., PROG. REPTS. OF THE ATL. BIOL. STAS., NO. 45 (APRIL 1949), PP. 3-6.
1952. MODIFICATION OF DRAGS TO PROTECT SMALL SCALLOPS. FISH. RES. BD. OF CAN., PROG. REPTS. OF THE ATL. CST. STAS., NO. 52 (JAN. 1952), PP. 8-14.
- POSGAY, J. A.
1951. THIRD REPORT ON INVESTIGATIONS OF METHODS OF IMPROVING THE SHELLFISH RESOURCES OF MASSACHUSETTS. IV. INVESTIGATIONS OF THE SEA SCALLOP, PECTEN GRANDIS. (PREPARED BY THE WOODS HOLE OCEANOGRAPHIC INSTITUTION), COMMONWEALTH OF MASS., DEPT. OF CONSERVATION, DIV. OF MARINE FISHERIES, PP. 24-30.
- ROUNSEFELL, G. A.
1948. DEVELOPMENT OF FISHERY STATISTICS IN THE NORTH ATLANTIC, U. S. DEPT. OF THE INTERIOR, FISH AND WILDLIFE SERVICE, SPEC. SCI. REPT. NO. 47, PP. 1-18, 9 FIGS.
- ROYCE, W. F.
1946. GEAR USED IN THE SEA SCALLOP FISHERY. COMM. FISH. REV., VOL. 8, NO. 12 (DEC. 1946), PP. 7-11.
- SMITH, H. M.
1891. THE GIANT SCALLOP FISHERY OF MAINE. BULL. OF THE U. S. FISH COMMISSION, VOL. IV FOR 1889 (PUBLISHED 1891), PP. 313-335.



FROZEN SCALLOPS

DO YOU KNOW THAT...

A total of 4,112,000 pounds of scallop meats (includes both sea and bay scallops) were frozen in the United States during 1952--slightly less than the 4,705,000 pounds frozen in 1951.

Of the total amount frozen in 1952, 3,481,000 pounds were frozen in the New England States, 536,000 pounds in the Middle Atlantic States, 74,000 pounds in the South Atlantic States, and the balance in the South Central and Pacific States.

The amount of scallop meats packed and frozen in consumer-size packages in 1952 amounted to 3,692,000 pounds--a substantial increase over the 2,546,000 pounds packed in 1951. (Included in these totals are breaded and cooked scallops.)



SEA SCALLOP
(Pecten magallanicus)