INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 893
(Dc. 5)

Document No. 31

ANNUAL MEETING - MAY/JUNE 1961

U. S. Research on the Georges Bank Sea Scallop Fishery during 1960

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Introduction

United States investigators have continued to interview the captains of sea scallop fishing vessels after each trip to obtain data on the location fished and the number of days spent on the grounds. The actual weight of meats landed per trip is later collected from the buyers. These data have been compiled by unit areas (10 minutes of longitude by 10 minutes of latitude) and a monthly summary of the landings from 5Z sent to ICNAF headquarters and to the St. Andrews Biological Station of the Fisheries Research Board of Canada. Canadian investigators have sent similar data for their fleet to the United States.

Data on the size composition of the landings have been obtained from samples of shells brought into port by the fishermen. One cruise was made with a research vessel using small-mesh gear to collect quantitative length-frequency samples of the populations present on the various fishing grounds as well as samples for calculating growth and mortality rates.

The Fishery

United States vessels landed 21.9 million pounds of sea scallop meats from Subarea 5Z as the result of 8031 days reported as spent on the grounds. Canadian vessels reported spending 2282 days on the grounds and landed 7.5 million pounds. The total landings of 29.4 million pounds are the largest in the history of this fishery (Table 1) and 13 percent higher than 1959. There were an additional 2.8 million pounds landed by U. S. vessels from outside the convention area and 0.2 million pounds landed by Canadian vessels from grounds other than those in 5Z. Total landings of sea scallop meats during 1960 were, therefore, 32.4 million pounds.

Table 1. Landings and effort of the United States and Canadian sea scallop fleets in Subarea 5Z 1951 - 1960.

	Millions of Pounds			Days on the Grounds		
YEAR	U. S.	CAN.	TOTAL	U. S.	CAN.	TOTAL
1951	12.4	0.2	12.6	7626	*	7700+
1952	12.1	0.2	12.3	7742	*	7800+
1953	16.3	0.3	16.6	10031	*	10000+
1954	15.5	0.2	15.7	9343	*	9000+
1955	18.3	0.3	18.6	11619	*	12000+
1956	17.5	0.7	18.2	12246	*	12000+
1957	17.3	1.8	19.1	10500	1075	11575
1958	14.4	2.6	17.0	8775	1463	10238
1959	18.7	4.4	23.1	8480	2019	10499
1960	21.9	7.5	29.4	8039	2282	10321

*Not available

1/ U. S. Department of the Interior, Fish and Wildlife Service, Bureau of Commercial Fisheries, Biological Laboratory, Woods Hole, Mass. U. S. A.

..../2

The grounds exploited most heavily by the fishermen during 1960 were the same grounds that they had fished heavily in 1959. Table 2 shows the amounts landed by both fleets separated according to the subareas of the United States reporting system (Figure 1). Subareas N and J were by far the most productive grounds in both 1959, 63 percent of the total landings, and 1960, 78 percent.

Table 2.--Landings of sea scallop meats from the six subareas of Georges Bank.

Area	1959 U. S.	1959 Canada	1959 Total	1960 U. S.	1960 Canada	1960 Total
G	0.3	--	0.3	1.8	--	1.8
H	1.9	--	1.9	1.4	--	1.4
O	1.8	--	1.8	0.7	--	0.7
M	1.5	2.5	4.0	2.0	0.4	2.4
N	6.1	--	6.1	9.8	--	9.8
J	6.6	1.9	7.5	5.8	7.1	12.9

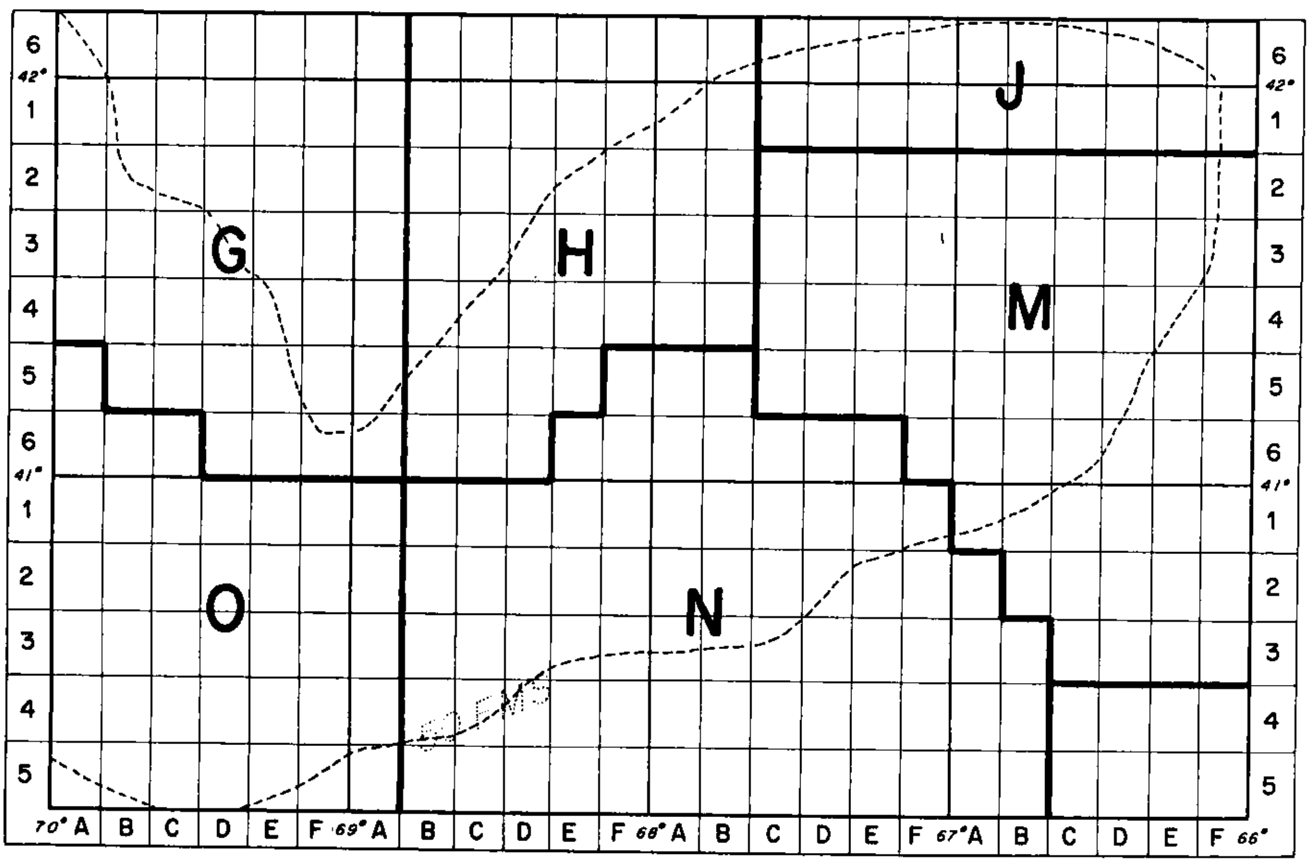

Figure 1.--United States statistical subareas on Georges Bank.

The samples collected to determine the size composition of the landings (Figure 1a) show almost the same sequence of events in both of the heavily fished areas. A new year class was recruited to the fishery during the second quarter of 1959 and soon became the dominant feature of the catch. This year class continued to support the fishery all through 1960 with no sign that there was any appreciable recruitment in that year on these grounds. The almost incredible abundance of this single year class is the reason that landings from 5Z rose from 17.0 million pounds in 1958 to 23.1 million pounds in 1959 and then to 29.4 million pounds in 1960 with just about the same amount of effort expended in each year (Table 1). The increased landings in 1960 over 1959 with almost no recruitment can be explained simply as a function of the increased average size of the scallops in the dominant year class.

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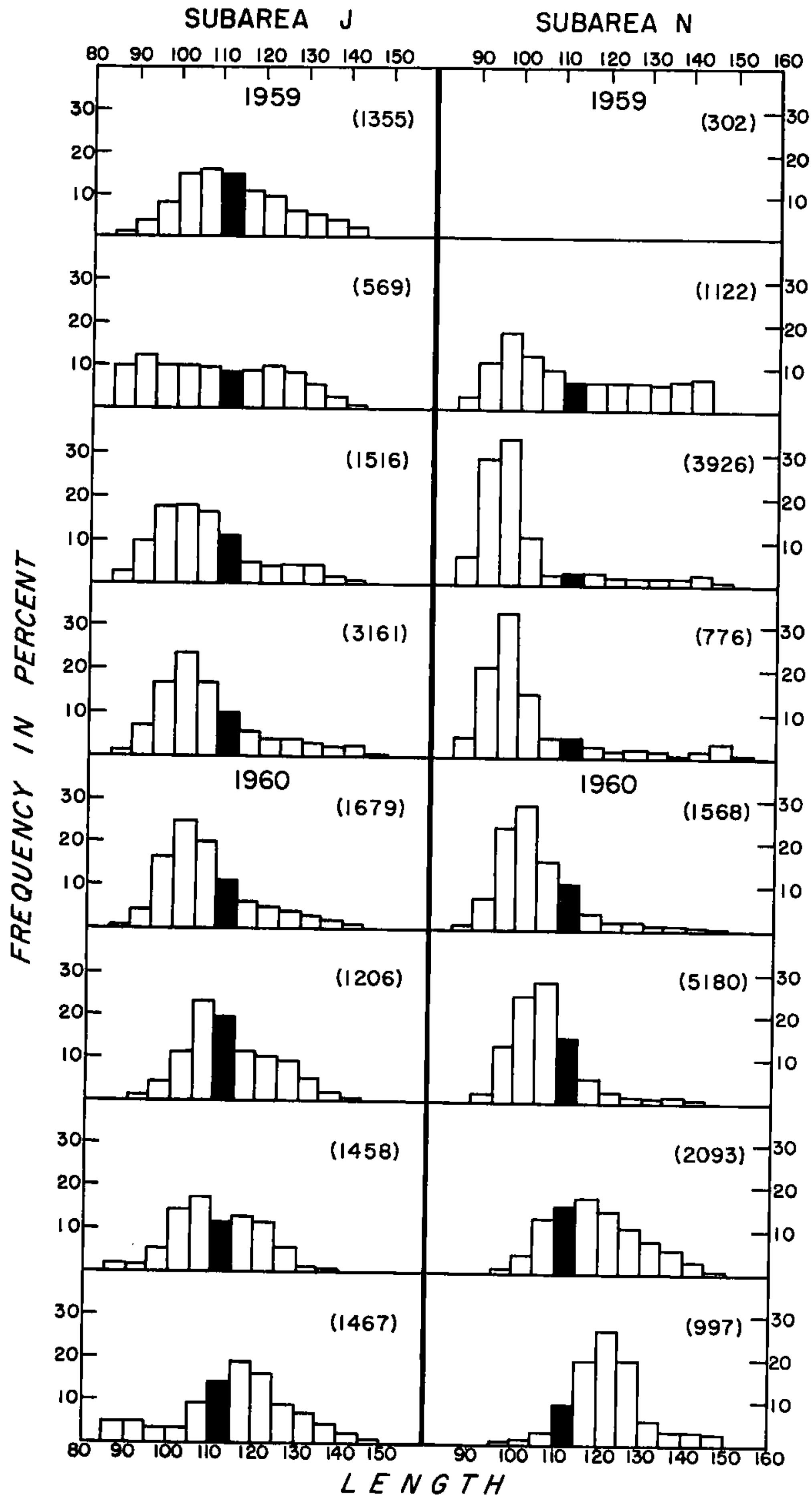

Figure 1a.--Size distribution of the landings from Subareas J and N by quarters in 1959 and 1960. The 110-115 mm. size category has been darkened as a visual reference. The numbers in parentheses are the landings of the U. S. fleet in thousands of pounds.

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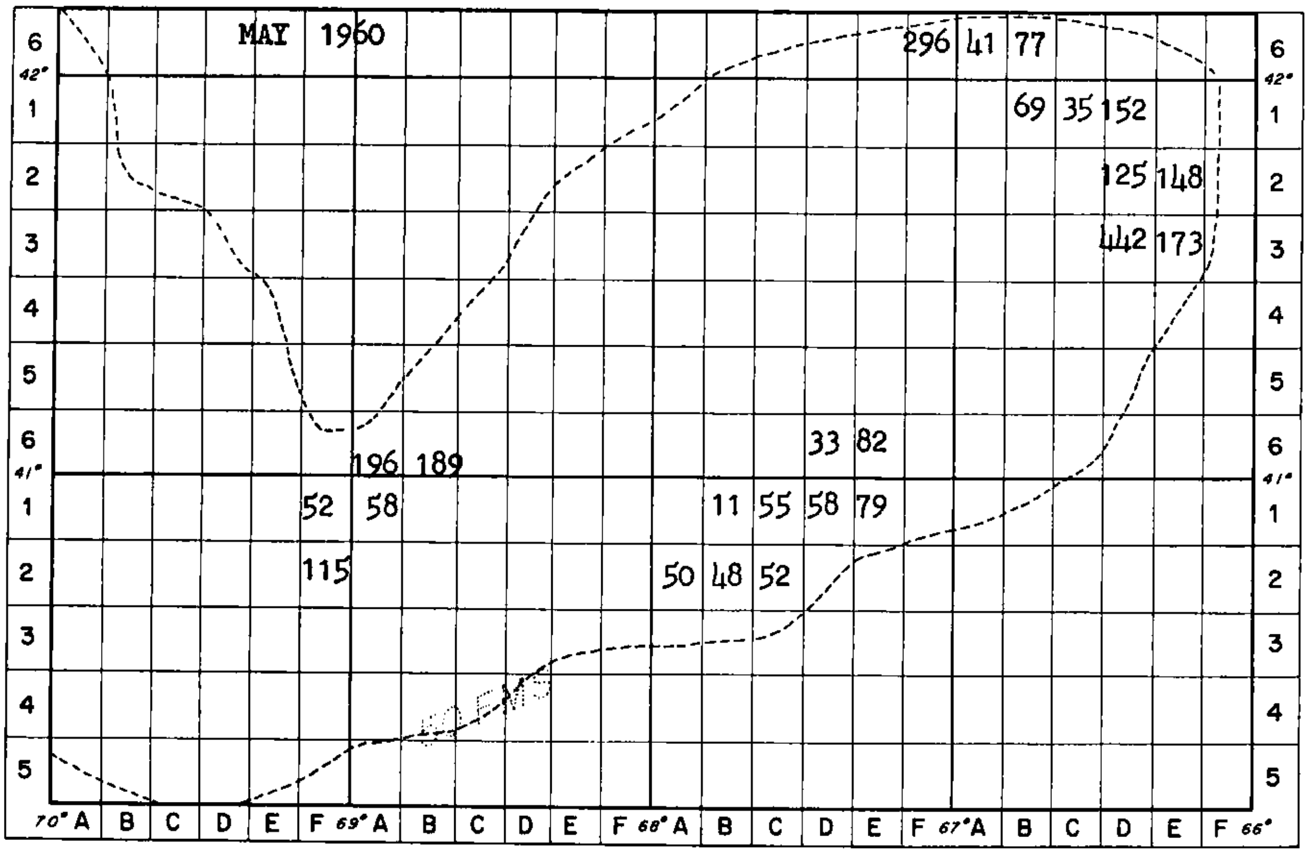

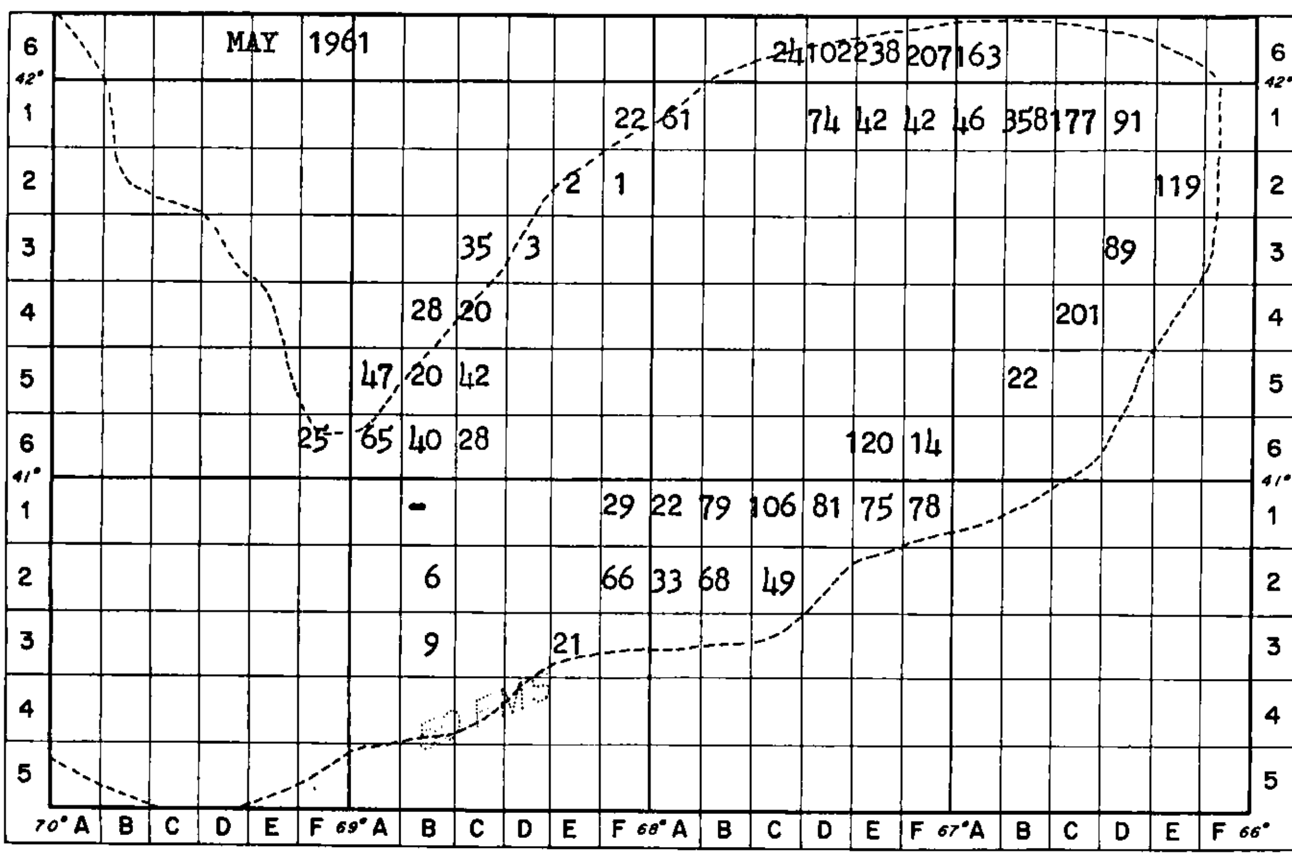

Figure 2. - Abundance of sea scallops over 70 mm. in numbers per 10, 000 square feet for the areas sampled in 1960 and 1961.

Abundance

Unfortunately, we cannot use the weight of meats landed per day spent on the grounds as a precise index of abundance. It is possible, when length frequency-distribution samples and a length-weight ratio are available, to convert weight into numbers but the effort figure still remains imprecise. There is some upper limit to the number of scallops that a man can shuck in a day. This figure will obviously

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vary from man to man and, depending upon the size of the crew, from boat to boat. So long as a boat can catch enough scallops to keep the shuckers busy, there will be no variation in the landings per day whether it has required 2 or 20 forty-minute tows of the dredges to catch them.

Since 1959 we have collected quantitative length-frequency samples on our research vessel cruises for abundance estimates. The areas sampled in 1959 were again sampled in 1960 and in 1961. The abundance figures for unit areas sampled at least twice during the three cruises are shown in Table 3. Only the 1961 cruise sampled the entire Bank; the other cruises were directed more toward sampling selected areas intensively (Figure 2). For this reason, comparing the pooled samples for each year does not give a very precise estimate of change of abundance over the whole Bank. It is, however, the best approximation we can now make. The 1959 samples gave an average of 197 sea scallops over 70 mm. per 10,000 square feet; 1960, 99 and 1961, 68. If only the unit areas sampled both in 1960 and 1961 are considered the values become 118 and 113.

Table 3.--Relative abundance of sea scallops over 70 mm. long in certain unit areas on Georges Bank for the years 1959, 1960, and 1961.

Unit Area		Numbers per 10,000 square feet		
		May 1959	May 1960	May 1961
41-68	B-6	255	189	40
40-69	F-2	57	115	--
40-67	A-2	--	50	33
	B-1	--	11	79
	B-2	--	48	68
	C-1	476	55	106
	C-2	--	52	49
	D-1	--	58	81
	E-1	--	79	75
41-67	E-6	--	82	120
41-66	B-1	--	69	358
	C-1	--	35	177
	D-1	--	152	91
	E-2	352	148	119
	D-3	92	442	89
	E-3	225	173	--

Growth Rate

We have calculated growth rates for all parts of Subarea 5Z which produce any appreciable fraction of the sea scallop catch. Table 4 gives a summary of these data. The scallops are fully recruited by age 4. During the next two years, they double in weight.

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Table 4. --Length and weight at age for five areas on Georges Bank

Location		41°31'N 66°31'W	41°03'N 68°46'W	41°51'N 66°23'W	42°09'N 67°14'W	40°55'N 67°35'W	Average	% inc. in wt.
Age								
4	L (mm.)	84.1	88.8	87.1	90.4	86.0	87.3	
	W (gm.)	9.2	13.6	10.3	9.3	9.8	10.4	
								57
5	L	98.9	103.2	102.5	103.0	101.0	101.7	
	W	14.8	21.0	15.8	13.8	16.2	16.3	
								34
6	L	110.0	113.3	113.9	112.5	113.0	112.5	
	W	20.1	27.6	20.9	17.9	23.0	21.9	
								22
7	L	118.5	120.5	122.4	119.6	122.5	120.7	
	W	25.0	33.0	25.2	21.6	29.2	26.8	
								16
8	L	124.8	125.6	128.6	125.0	130.0	126.8	
	W	29.1	37.2	28.8	24.7	35.6	31.1	
								12
9	L	129.7	129.1	133.2	129.1	137.0	131.6	
	W	32.5	40.4	31.6	27.2	41.9	34.7	
								9
10	L	133.3	131.4	136.7	132.2	143.0	135.3	
	W	35.2	42.3	33.8	29.2	47.9	37.7	

Natural Mortality Rate

A considerable amount of clapper:live scallop ratio data has been accumulated since 1958.

Year	Clappers	Live	C/L
1958	567	29599	.019
1959	949	48473	.020
1960	1561	18278	.085
1961	2820	39097	.072
Total	5897	135447	.044

The high values recorded in 1960 and 1961 are the result of finding some "graveyards" (Figure 3) in those years. We have no good explanation for this occurrence but suggest as possibilities: some sort of localized epidemic; the remains of deckloads shoveled back overboard after they became too ripe to shuck; and/or the rapid removal of live scallops by the fleet while returning the clappers causing an artificially high ratio. In any case using 100 days as the time required for clappers to separate gives an estimate of M = .16 from the pooled data.

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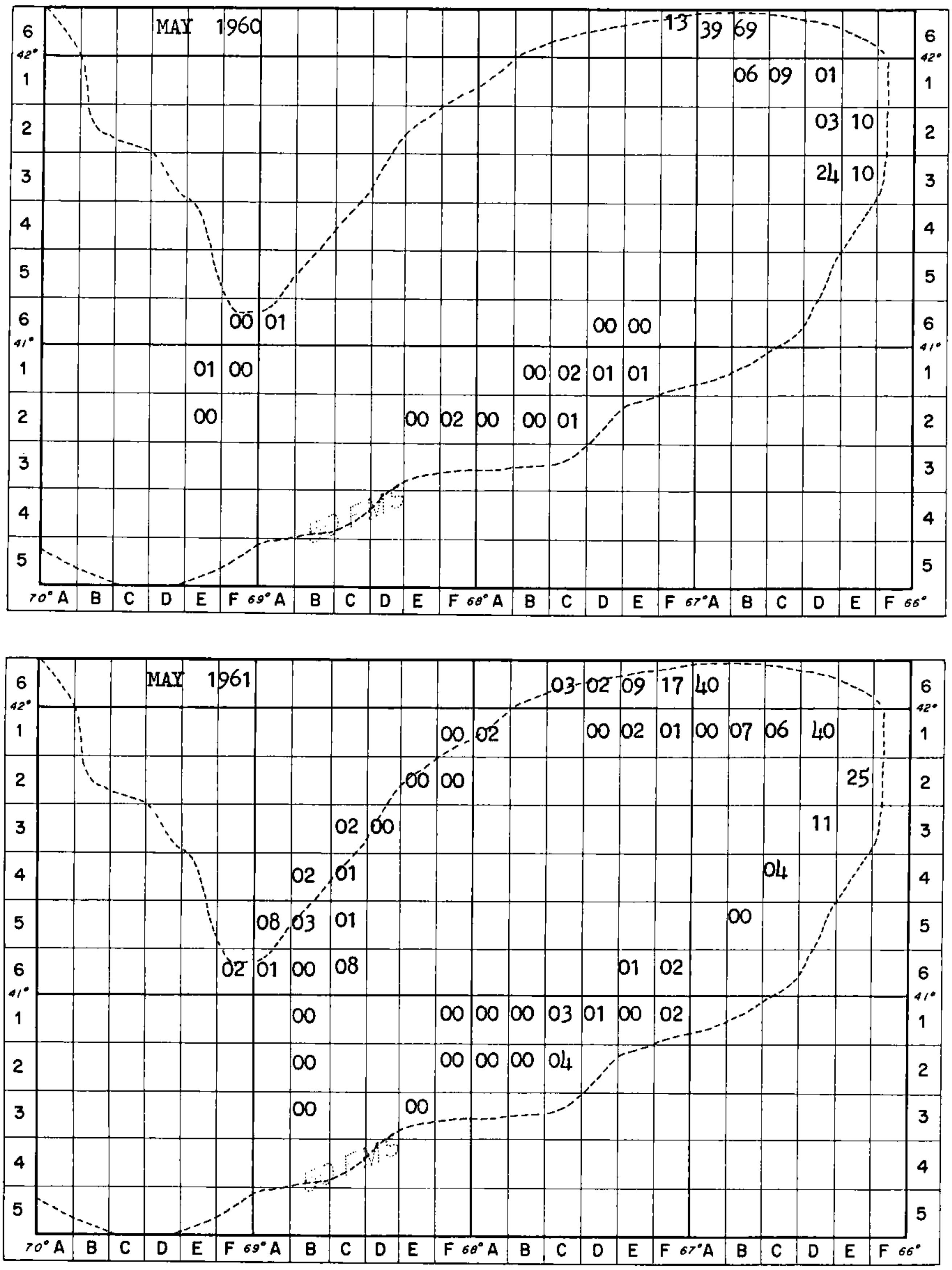

Figure 3. --Clapper:live scallop ratio in percent for areas sampled in 1960 and 1961.

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Total Mortality Rate

Only one unit area, 40-67 C-1, was sampled well enough in all three years to give reliable estimates of the total mortality rate. The numbers remaining of the 476/10,000 square feet found in 1959, subtracting recruitment, were 52 in 1960 and 38 in 1961. These give estimates of Z equal to 2.22 and .30, respectively.

Seven unit areas, 40-67; A-2, B-1, B-2, C-1, C-2, D-1, and E-1, were well sampled in both 1960 and 1961. Pooling all the samples for these areas gives an average abundance in May 1960 of 50/10,000 square feet, reduced in May 1961 to 20; an estimate of Z = .92.

Fishing Mortality Rate

Using the data available from that part of Georges Bank which is best documented, the 7 unit areas mentioned above, we found Z = .92 and M = .05; resulting in F = .87. This resulted from an average effort per unit area of 228 days spent on the grounds during the time between sampling.

Predicted Yield

Using an average mortality rate of .10, the best available before the 1961 samples were collected, we have calculated yields for various values of F and various ages of first capture using the average growth rate of Table 4. These are presented in Table 5.

Table 5.--Yield in weight per recruit, in arbitrary units, for various ages of first capture and levels of fishing effort

Age at first capture	4	5	6	7	8
F					
.20	123	133	141	143	141
.40	115	136	149	155	157
.60	106	132	149	158	161
.80	100	129	148	158	163
1.00	96	127	147	159	164
1.20	93	125	146	159	165
1.40	90	124	146	159	165
1.60	89	123	146	159	165

These calculations show a remarkable stability of yield over wide ranges of fishing pressure and a large increase in yield if capture were to be delayed beyond the present recruitment age 4.

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