INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

DALHOUSIE UNIVERSITY,
HALIFAX, NOVA SCOTIA,
CANADA.

SERIAL NO. 1111
(D. A. 62)

DOCUMENT NO. 40

ANNUAL MEETING - JUNE, 1963

SPANISH RESEARCH REPORT, 1963

PART B

AGE AND GROWTH OF COD (GADUS MORHUA) OF THE NORTHWEST ATLANTIC FISHERIES IN 1962

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I. - INTRODUCTION

THIS PAPER DEALS WITH THE RESULTS OF THE STUDY ON AGE AND GROWTH OF COD (GADUS MORHUA) CAUGHT BY SPANISH TRAWLERS IN THE ICNAF AREA IN 1962. RESULTS OF SEX RATIO AND AGE AT FIRST MATURITY ARE ALSO GIVEN, AS WELL AS COMPARATIVE EVOLUTION OF GROWTH AND DOMINANCE OF YEAR CLASSES IN THE DIVISIONS BEST KNOWN FROM SAMPLES SO FAR STUDIED.

MATERIAL, WHOSE CHARACTERISTICS ARE GIVEN FURTHER ON, HAS BEEN SUPPLIED BY THE DIRECCIÓN GENERAL DE PESCA MARÍTIMA THROUGH THE SECRETARY OF THE SCIENTIFICAL-FISHING STUDY BOARD, D. OLEGARIO RODRÍGUEZ MARTÍN, AND WAS COLLECTED BY THE OBSERVER D. TOMÁS GARCÍA LESTÓN ON BOARD TRAWLERS OF THE FIRM PYSBE (PESQUERÍAS Y SECADEROS DE BACALEO DE ESPAÑA, S. A.). WE ARE MOST PLEASED TO THANK THEM ALL WITH THESE LINES.

II. - MATERIAL AND METHODS

THE TOTAL SAMPLE CONSISTED OF 697 SPECIMENS (TABLES I AND II), 648 (92,96 %) OF WHICH PROVIDED SATISFACTORY OTOLITH READINGS. FIG. 1 SHOWS THE LOCATION AND LOT NUMBER OF EACH SAMPLE.

THE MONTHS WITH THE LARGEST NUMBER OF SPECIMENS ARE: MAY (182), AUGUST (181), JULY (146), OCTOBER (97), SEPTEMBER (41), MARCH (31), APRIL (10) AND NOVEMBER (8). THEREFORE, SAMPLES WERE TAKEN DURING EIGHT MONTHS. THE MONTHS MAY, AUGUST AND OCTOBER ALSO HAD THE LARGEST SAMPLES IN 1961. SAMPLES COLLECTED IN MAY ARE ALL FROM DIVISION 2J, WHICH IS THE BEST REPRESENTED (368 SPECIMENS) AS WELL AS DIVISION 3L (141), MOST OF WHICH ARE OF JULY. SAMPLES FROM THE OTHER DIVISIONS ARE SMALLER, AND DIVISIONS 1C, 3M, 3O, AND 3P ARE NOT STUDIED OWING TO THE SCARCITY OF NUMBERS SAMPLED.

THE BEST REPRESENTED LENGTH GROUPS RANGE FROM 51 TO 62 CM IN DIVISION 1B; FROM 48 TO 62 CM IN 2J; FROM 51 TO 62 CM IN 3K; FROM 45 TO 59 CM IN 3L, BEING THE EXTREMES 33 CM (3L) AND 90 CM (2J), EXISTING ALSO A SPECIMEN 105 CM LONG AND ANOTHER ONE 133 CM LONG IN DIVISION 2J.

METHODS ARE THE SAME AS THOSE USED IN PREVIOUS RESEARCH.

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III. - GROWTH

GROWTH CURVES OBTAINED FOR THE YEAR 1962 (FIG. 2 AND 3) ARE COMPARED TO THOSE OF PREVIOUS YEARS IN THE SAME DIVISIONS, CONSIDERING ONLY THE ONES FROM WHICH A SUFFICIENT NUMBER OF SPECIMENS IS AVAILABLE: 1B, 2J, 3L AND 3K IN 1962.

IT WILL BE NOTED WHEN CONSIDERING DIVISION 1B (FIG. 2) THAT THE SCARCITY OF DATA FOR 1962 CAUSES THE POINTS NOT TO COINCIDE, EXCEPT FOR AGE GROUP IV, WHICH IS BETTER REPRESENTED. THEREFORE, NO CONCLUSIONS CAN BE DRAWN.

ON THE OTHER HAND, DIVISION 2J OFFERS BETTER OPPORTUNITIES FOR COMPARISON. FIRST, IT IS NOTICEABLE THAT THE 1962 GROWTH CURVE LIES BELOW THOSE FOR 1960 AND 1961 TO AGE GROUP VI, THEN IT GOES OVER THEM, EXCEPT AT AGE GROUP X. THIS DIFFERENCE OF LENGTHS FOR EACH AGE GROUP, WHICH RANGES FROM 1 TO 3 CM MUST NOT BE DISREGARDED, BEARING IN MIND THAT THERE WAS A VERY WELL MARKED COINCIDENCE IN 1960 AND 1961 AND, MOREOVER, THAT DIVISION 2J SHOWS THE SLOWEST GROWTH OF ALL THE DIVISIONS WE HAVE STUDIED IN THE CONVENTION AREA.

CONSIDERING DIVISIONS 3K AND 3L (FIG. 3) WE SEE THAT THE LATTER SHOWS GENERALLY A FASTER GROWTH RATE ESPECIALLY AT THE OLDEST AGE GROUPS. COMPARING DIFFERENT YEARS IN THE SAME DIVISION IT CAN BE NOTICED THAT THE GROWTH RATE IN 3L IN 1962 IS SLOWER THAN IN 1960 AND 1961 EXCEPT FOR SPECIMENS OF EXTREME LENGTH GROUPS, WHICH ARE POORLY REPRESENTED. HOWEVER, SUCH A SIGNIFICANT DIFFERENCE IS NOT OBSERVED IN DIVISION 3K, ESPECIALLY FOR AGE GROUPS IV TO VII, WHICH ARE THE BEST REPRESENTED.

FINALLY, COMPARING GROWTH IN ALL DIVISIONS STUDIED SO FAR (FIG. 4), THE FOLLOWING CONCLUSIONS ARE REACHED:

A) GROWTH IS FASTER IN SUB-AREA 1 THAN IN ALL THE OTHERS.

B) GROWTH RATE DECREASES FROM NORTH TO SOUTH IN SUB-AREA 1 (IT IS FASTER IN 1B THAN IN 1D).

C) IN SUB-AREAS 2, 3 AND 4 GROWTH RATE INCREASES FROM NORTH TO SOUTH (4V, 3L AND 3K HAVE A FASTER GROWTH THAN 2J).

IV. - LENGTH, AGE AND YEAR-CLASS FREQUENCIES

THE STUDY OF GRAPHS OF AGE AND YEAR-CLASS FREQUENCIES (FIG. 7 AND 8) AND LENGTH FREQUENCIES (FIG. 5 AND 6) ARRANGED BY DIVISIONS SHOWS:

A) FOR LENGTHS (FIG. 5 AND 6)

1. IN DIVISION 3L, MODE AND MEAN LENGTH DECREASED FROM 62 CM IN 1960 TO 56 CM IN 1962, I.E., 6 CM IN TWO YEARS; THIS NEEDS TO BE CONFIRMED, BUT IT IS NOT UNLIKELY DUE TO AN OVERFISHING OF THE DIVISION, WHICH IS ONE OF THE MOST WIDELY FISHED BECAUSE OF ITS LOCATION NORTH OF THE GRAND BANK OF NEWFOUNDLAND.

2. MODE AND MEAN LENGTH HAVE ALSO DECREASED 7 CM IN DIVISION 1B.

3. MEAN LENGTH HAS DECREASED SINCE 1960 IN DIVISION 2J, BUT IT IS SLIGHTLY HIGHER, A LITTLE MORE THAN ONE CENTIMETER, THAN IN 1961.

4. ON THE OTHER HAND, BOTH MODE AND MEAN LENGTH HAVE INCREASED ALMOST 2 CM IN DIVISION 3K.

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IV. - LENGTH, AGE AND YEAR-CLASS FREQUENCIES (CONT'D)

B) FOR YEAR CLASSES (FIG. 7 AND 8)

1. MEAN AGE HAS GONE DOWN IN DIVISION 1B FROM 5.45 YEARS IN 1960 TO 4.10 YEARS IN 1962. HOWEVER, THE DIFFERENCES IN NUMBER OF THE SPECIMENS AVAILABLE IN BOTH YEARS (328 IN 1960 AND 67 IN 1962) DO NOT MAKE AN ACCURATE COMPARISON POSSIBLE. IN 1962 THE 1958 YEAR-CLASS IS THE MOST ABUNDANT, WHEREAS IN 1960 THE 1954 YEAR-CLASS WAS THE MOST ABUNDANT.

2. AGE GROUP IV IS ALSO DOMINANT IN DIVISION 2J, DESPITE MEAN AGES BEING 7.34, 6.67 AND 7.44 FOR THE YEARS 1960, 1961 AND 1962. THIS AGREES FAIRLY WELL WITH THE STABILITY OF MEAN LENGTHS AND WITH THE SLOW GROWTH RATE TYPICAL OF THIS DIVISION.

3. DIVISION 3K SHOWS A SLIGHT DECREASE OF MEAN LENGTH, AND AT THE SAME TIME MORE EVIDENT DOMINANCE OF THE 1956 YEAR-CLASS (SPECIMENS 6 YEARS OLD), 22% OF THE TOTAL SAMPLE.

4. MEAN AGE REMAINS ALMOST THE SAME IN DIVISION 3L DESPITE THE DECREASE OF MEAN LENGTH, WHILE THE PREDOMINANCE OF 1957 YEAR-CLASS IS BECOMING EVIDENT (FISH AGED 5).

V. - SEX RATIO

THE MAJORITY OF COD ARE FEMALES, THOUGH THE MAJORITY IS NOT SO GREAT AS IN 1961. IT IS MOST SIGNIFICANT IN DIVISION 3M (81.8% OF FEMALES) AND LEAST MARKED IN DIVISION 3K (55.8% OF FEMALES). THE LATTER, ALONG WITH DIVISION 2J (66.4% OF FEMALES) SHOW AN ALMOST NORMAL PROPORTION. IT WAS OBSERVED IN 1961 THAT THESE TWO DIVISIONS HAD A LARGER PROPORTION OF MALES, WHILE IN THE OTHER DIVISIONS FEMALES WERE AND STILL ARE WIDELY PREDOMINANT.

IN THE TOTAL SAMPLE (TABLE III), MALES ARE 31.2%, AND FEMALES 68.8%. THUS THE PROPORTION OF MALES HAS INCREASED SINCE 1961 WHEN IT WAS ONLY 24%.

VI. - AGE AT FIRST MATURITY

THE STUDY OF AGE AT FIRST MATURITY BY THE MEANS OF SPAWNING MARKS IN DIFFERENT YEAR-CLASSES AND DIVISIONS LEADS TO THE FOLLOWING CONCLUSIONS:

A) A GREAT MAJORITY (71.4%) OF THE COD ATTAIN FIRST MATURITY AT THE AGE OF 6 YEARS.

B) SOME COD ATTAIN FIRST MATURITY AT THE AGE OF 5 YEARS (10.2%), AT THE AGE OF 7 YEARS (15.3%) OR AT THE AGE OF 8 YEARS (3.1%).

C) THERE IS NO SIGNIFICANT DIFFERENCE IN THE AGE AT FIRST MATURITY BETWEEN MALES AND FEMALES FROM THE SAME DIVISION.

D) RESULTS ARE QUITE SIMILAR TO THOSE OBTAINED FOR 1961.

E) AGE AT FIRST MATURITY SEEMS TO BE BECOMING HIGHER IN OLDER YEAR-CLASSES AND SMALLER IN YOUNGER ONES. THIS CANNOT BE GIVEN AS DEFINITIVE OWING TO THE SCARCITY OF DATA.

VII. - SUMMARY AND CONCLUSIONS

THE MAIN CONCLUSIONS ARE:

A) GROWTH CURVES OF COD FROM DIVISIONS 1B, 2J, 3K AND 3L IN 1962 SHOW A DECREASE OF THE GENERAL GROWTH RATE WHEN COMPARED WITH THAT FOR PRECEDING YEARS, EXCEPT FOR AGE GROUPS OVER VI IN DIVISION 2J.

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VII. - SUMMARY AND CONCLUSIONS (CONT'D)

B) GROWTH RATE IS FASTER IN SUB-AREA 1 THAN IN THE OTHERS, AND DECREASES FROM NORTH TO SOUTH, BEING REVERSED IN THE CASE OF SUB-AREAS 2, 3 AND 4.

C) MEAN LENGTH IS SMALLER IN 1962 THAN IN PRECEDING YEARS IN DIVISIONS 3L, 1B AND 2J, AND HIGHER IN DIVISION 3K.

D) DOMINANT YEAR-CLASSES ARE: 1956 IN DIVISIONS 2J AND 3K, 1957 IN 3L AND 1958 IN 1B.

E) PROPORTION OF MALES (31%) IS HIGHER THAN IN 1961 (24%).

F) A MAJORITY OF SPECIMENS (71.4%) OF ALL YEAR-CLASSES REACH FIRST MATURITY AT THE AGE OF 6 YEARS.

VIGO, APRIL, 1963
LABORATORY OF THE INSTITUTO DE INVESTIGACIONES PESQUERAS,
PATRONATO "JUAN DE LA CIERVA".

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TABLE I

SERIAL NUMBER, DATE, NUMBER OF SPECIMENS AND DIVISION OF EACH LOT OF SAMPLES

LOT	DATE	NUMBER OF SPECIMENS	ICNAF DIVISION	LOT	DATE	NUMBER OF SPECIMENS	ICNAF DIVISION
	MARCH				AUGUST		
1	7	15	3L	20	9	19	1C
2	8	16	3P	21	15	31	1B
		31		22	16	22	1B
	APRIL			23	18	18	1B
3	1	10	3L	24	26	25	2J
				25	28	31	2J
	MAY			26	29	14	2J
4	21	24	2J	27	31	21	2J
5	22	34	2J			181	
6	25	16	2J		SEPTEMBER		
7	25	14	2J	28	1	15	2J
8	26	12	2J	29	27	26	2J
9	28	10	2J			41	
10	29	23	2J		OCTOBER		
11	30	25	2J	30	1	22	2J
12	31	24	2J	31	3	11	2J
		182		32	24	20	2J
	JULY			33	25	12	3K
13	4	22	3L	34	26	19	3K
14	5	27	3L	35	26	13	3K
15	6	25	3L			97	
16	8	26	3L				
17	11	16	3L		NOVEMBER		
18	18	11	3M	36	19	8	3K
19	21	19	3O				
		146					

TABLE II

DISTRIBUTION OF SAMPLES BY DIVISIONS, DATES AND NUMBER OF SPECIMENS

DIVISION	LOT	DATES	NO. SPECIMENS	TOTAL
1B	21 A 23	AUGUST 15, 16, 18	31, 22, 18	71
1C	20	AUGUST 9	19	19
2J	4 A 12	MAY 21, 22, 25, 26, 28, 29, 30, 31	24, 34, 16, 14, 12, 10, 23, 25, 24,	368
	24 A 27	AUGUST 26, 28, 29, 31	25, 31, 14, 21	
	28,29	SEPTEMBER 1, 27	15, 26	
	30 A 32	OCTOBER 1, 3, 24	22, 11, 20	
3K	33 A 35	OCTOBER 25, 26	12, 19, 13	52
	36	NOVEMBER 19	8	
3L	1	MARCH 7	15	141
	3	APRIL 1	10	
	13 A 16	JULY 4, 5, 6, 8	22, 27, 25, 26	
	17	JULY 11	16	
3M	18	JULY 18	11	11
3O	19	JULY 21	19	19
3P	2	MARCH 8	16	16
			TOTAL	697

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TABLE III

DISTRIBUTION OF SAMPLES, BY DIVISIONS, NUMBER OF SPECIMENS WITH GOOD READINGS, SEX-RATIO AND SPECIMENS WITH SPAWNING MARKS

ICNAF DIVISION	FISH IN SAMPLE NUMBER	FISH OTOLITHS READ NUMBER	%	MALES		FEMALES		WITH SPAWNING MARKS	
				NUMBER	%	NUMBER	%	NUMBER	%
1B	71	67	94.2	26	36.4	45	53.6	0	0
1C	19	19	100.0	5	26.3	14	73.7	1	5.1
2J	368	347	94.2	124	33.6	244	66.4	84	25.5
3K	52	46	88.4	23	44.2	29	55.8	10	19.2
3L	141	130	92.2	28	19.8	113	80.2	4	2.8
3M	11	10	90.9	2	18.1	9	81.9	0	0
3O	19	19	100.0	6	31.5	13	68.5	0	0
3P	16	16	100.0	4	25.0	12	75.0	0	0
TOTALS	697	648	92.96	218	31.2	479	68.8	99	14.2

TABLE IV

MEAN LENGTH FOR EACH AGE, ABSOLUTE AND RELATIVE AGE FREQUENCIES, YEAR CLASSES AND MEAN AGE FOR DIVISIONS

AGE AND YEAR CLASS	1B			2J			3K			3L		
	CM	No.	%	CM	No.	%	CM	No.	%	CM	No.	%
III (1959)	53.1	11	16.7	42.3	6	1.7	44.3	3	6.5	43.8	19	14.6
IV (1958)	58.7	41	62.1	46.2	48	13.8	49.7	4	8.7	46.4	22	16.9
V (1957)	59.5	14	21.2	51.7	60	17.3	54.7	8	17.4	53.3	32	24.6
VI (1956)				56.8	63	18.2	60.6	10	21.7	60.0	27	20.8
VII (1955)				59.4	33	9.5	62.0	5	10.9	63.2	10	7.7
VIII (1954)	80.0	1	1.4	62.2	30	8.6	70.6	5	10.9	69.8	9	6.9
IX (1953)				64.6	17	4.9	64.3	3	6.5	70.0	6	4.6
X (1952)				62.8	29	8.4	61.2	5	10.9	74.5	4	3.1
XI (1951)				67.2	15	4.3	67.0	1	2.2			
XII (1950)				68.2	16	4.6	69.0	1	2.2	77.0	1	0.8
XIII (1949)				73.7	12	3.5	82.0	1	2.2			
XIV (1948)				71.0	10	2.9						
XV (1947)				84.0	3	0.9						
XVI (1946)				82.6	3	0.9						
XVII (1945)				133.0	1	0.3						
XVIII (1944)				70.0	1	0.3						
TOTAL No.	67			347			46			130		
MEAN AGE	4.10			7.44			6.80			5.50		

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TABLE V

DISTRIBUTION OF LENGTH FREQUENCIES AND MEAN LENGTHS BY DIVISIONS

LENGTH CM	1 B		2 J		3 K		3 L	
	No.	%	No.	%	No.	%	No.	%
33-35							2	1.5
36-38							0	0.0
39-41			4	1.1			1	0.8
42-44			20	5.7	2	4.3	13	10.0
45-47	1	1.1	22	6.3	2	4.3	13	10.0
48-50	6	8.9	34	9.7	2	4.3	15	11.5
51-53	8	11.9	39	11.2	5	10.9	14	10.8
54-56	10	14.9	33	9.5	5	10.9	12	9.2
57-59	16	23.9	44	12.6	4	8.7	17	13.1
60-62	13	19.4	44	12.6	7	15.2	12	9.2
63-65	4	5.9	26	7.7	2	4.3	7	5.4
66-68	3	4.4	24	6.9	6	13.0	7	5.4
69-71	4	5.9	18	5.1	3	6.5	6	4.6
72-74	1	1.1	11	3.1	2	4.3	3	2.3
75-77	0	0.0	7	2.0	3	6.5	2	1.5
78-80	1	1.1	4	1.1	2	4.3	1	0.8
81-83			2	0.4	1	2.2	1	0.8
84-86			2	0.4			3	2.3
87-89			3	0.8				
90-92			2	0.4				
93-95								
.....								
105-107			1	0.2				
.....								
132-134			1	0.2				
TOTAL No.	67		341		46		129	
MEAN LENGTH	58.4		58.72		61.39		56.11	

TABLE VI

AGE AT FIRST MATURITY FOR YEAR CLASSES AND DIVISIONS

YEAR CLASS	2 J								3 K				3 L		1 C
	MALES				FEMALES				MALES		FEMALES		MALES	FEMALES	FEMALE
	5	6	7	8	5	6	7	8	6	7	6	7	6	6	6
1946 (16)						1									
1947 (15)								1							
1948 (14)		2	1			2	2								
1949 (13)		2				2	3								
1950 (12)		4	1			3	2	1				1		1	
1951 (11)		3		1		6	2		1						
1952 (10)	1	8			1	10	2				4			1	
1953 (9)	2	2			1	5	1		1		2		1	1	1
1954 (8)	2	3			3	2			1						
1955 (7)		1													
TOTALS	5	25	2	1	5	31	12	2	3		6	1	1	3	1
%	AT THE AGE OF 5 - 10.2				AT THE AGE OF 6 - 71.4				AT THE AGE OF 7 - 15.3				AT THE AGE OF 8 - 3.1		

Fig. 1: (below) Map of the location of catches made in 1962 in the Convention Area.

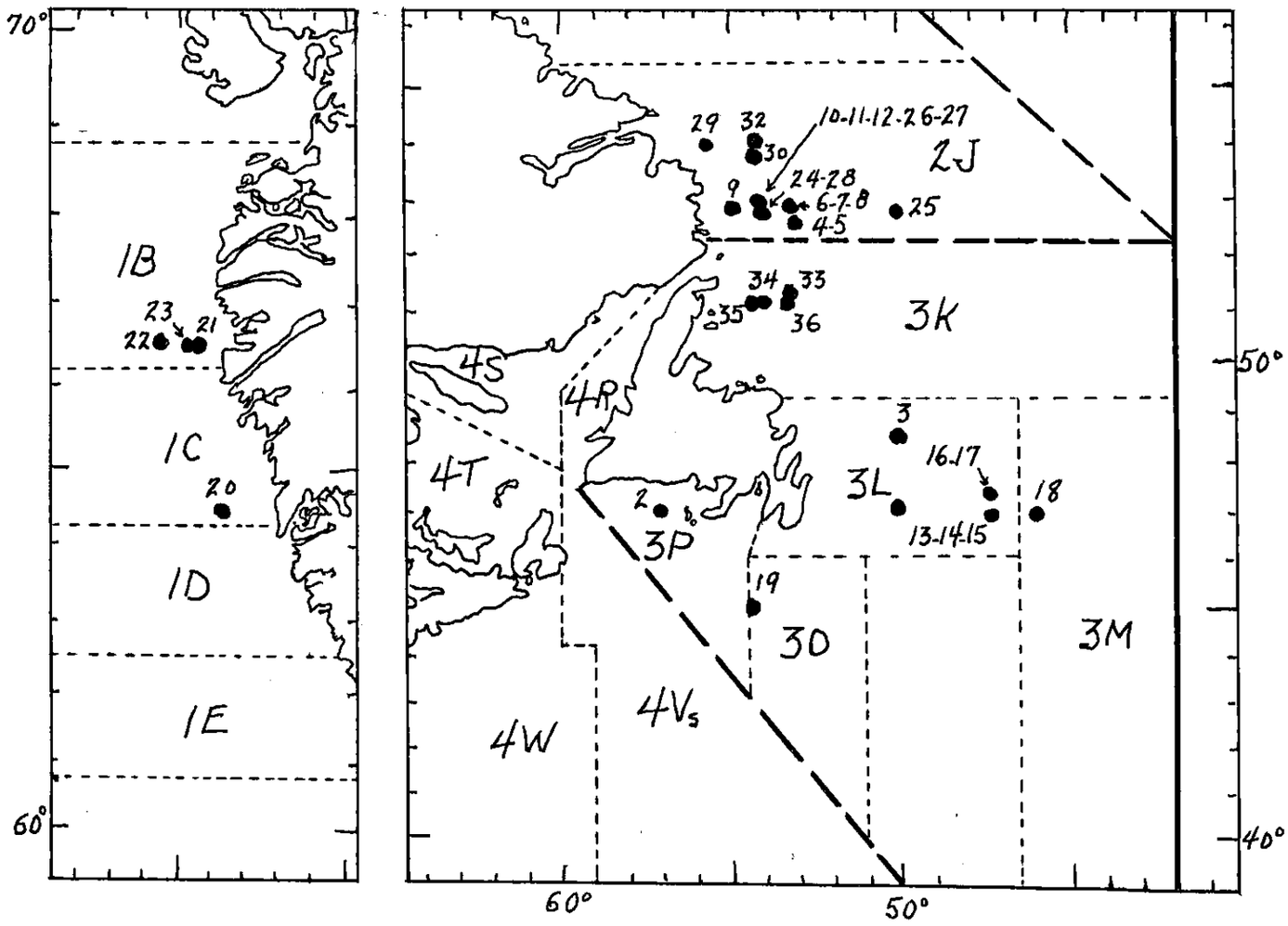
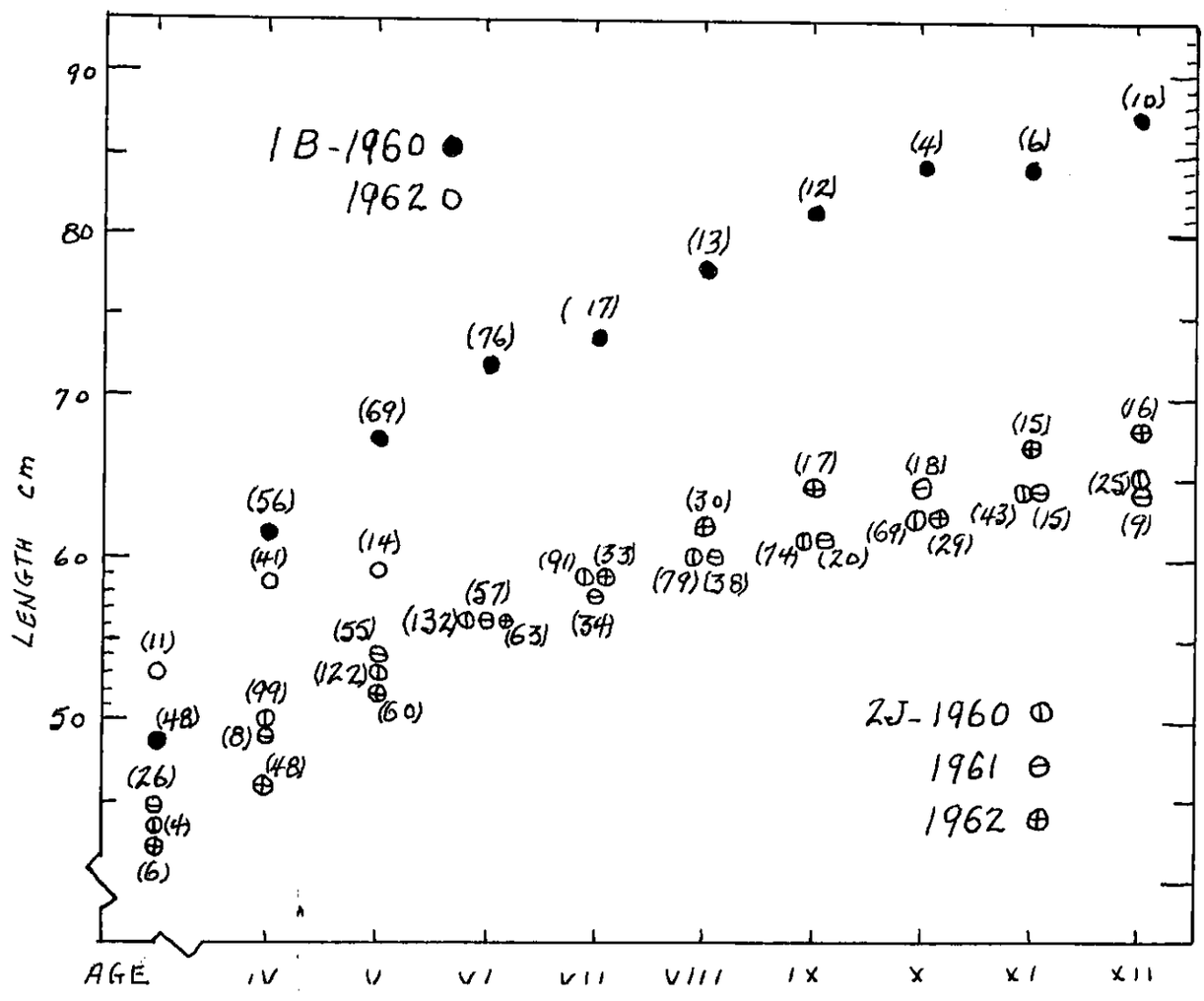


Fig. 2: (below) Growth curves of cod from Divisions 1B (1960, 1962) and 2J (1960, 1961 and 1962)



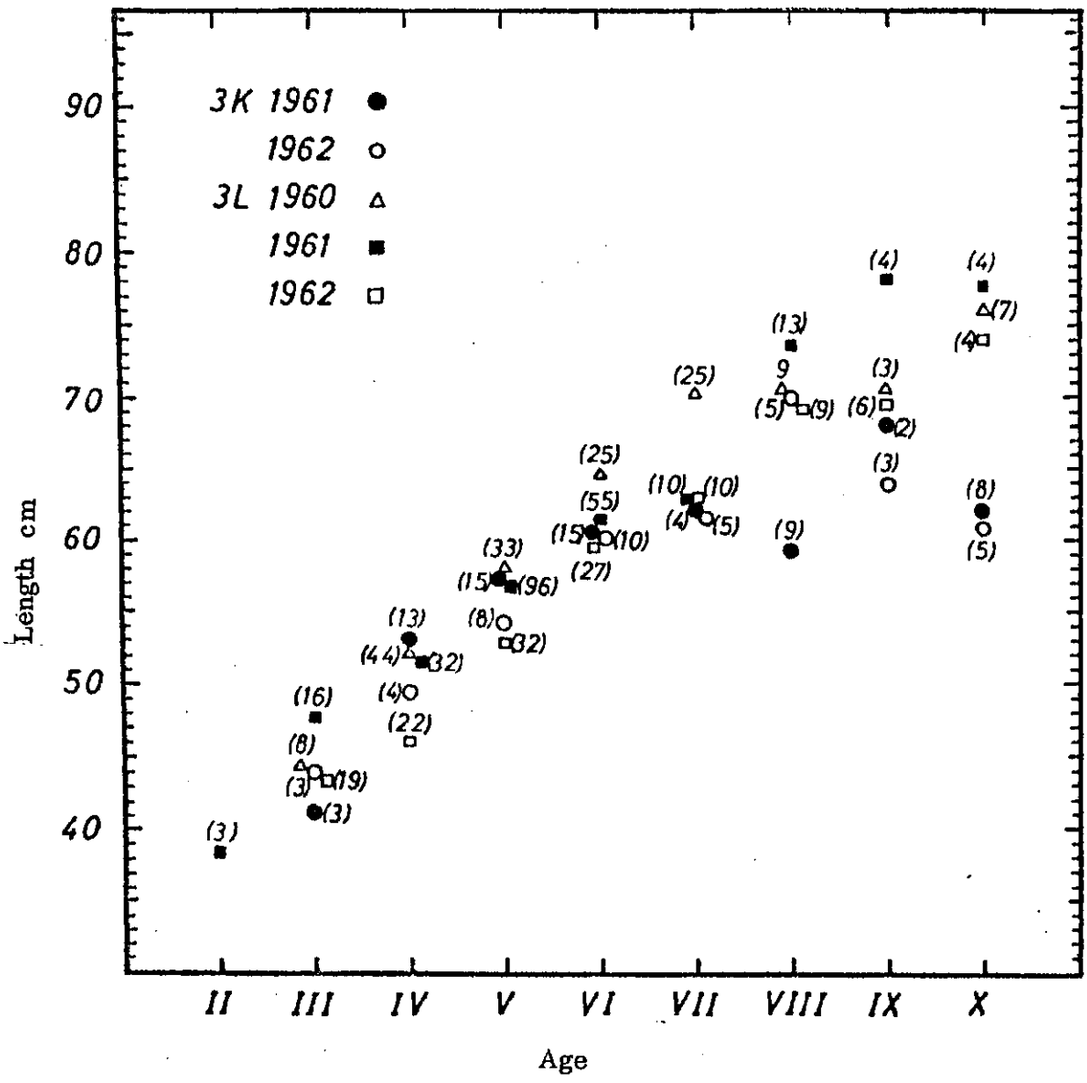


FIGURE 3 - GROWTH CURVES OF COD FOR DIVISIONS 3K (1961, 1962 AND 3L (1960, 1961 AND 1962)

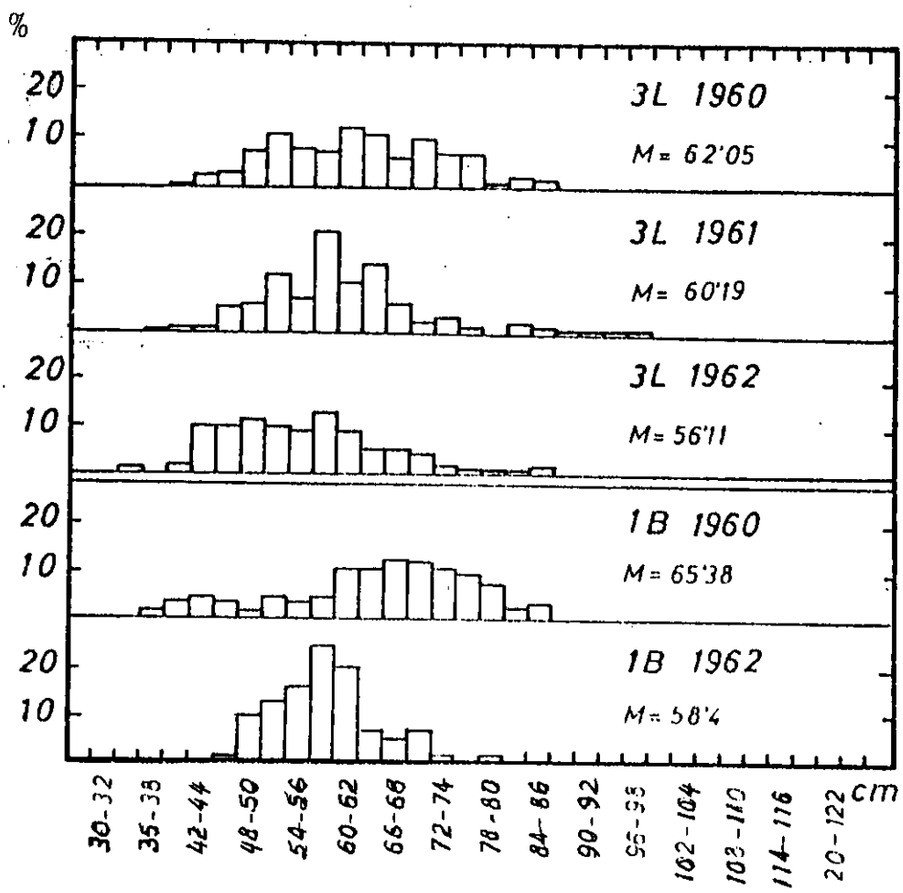


FIGURE 5 - RELATIVE LENGTH FREQUENCIES OF COD ARRANGED IN 3-CM LENGTH GROUPS, FOR DIVISION 3L (1960, 1961 AND 1962) AND 1B (1960, 1962)

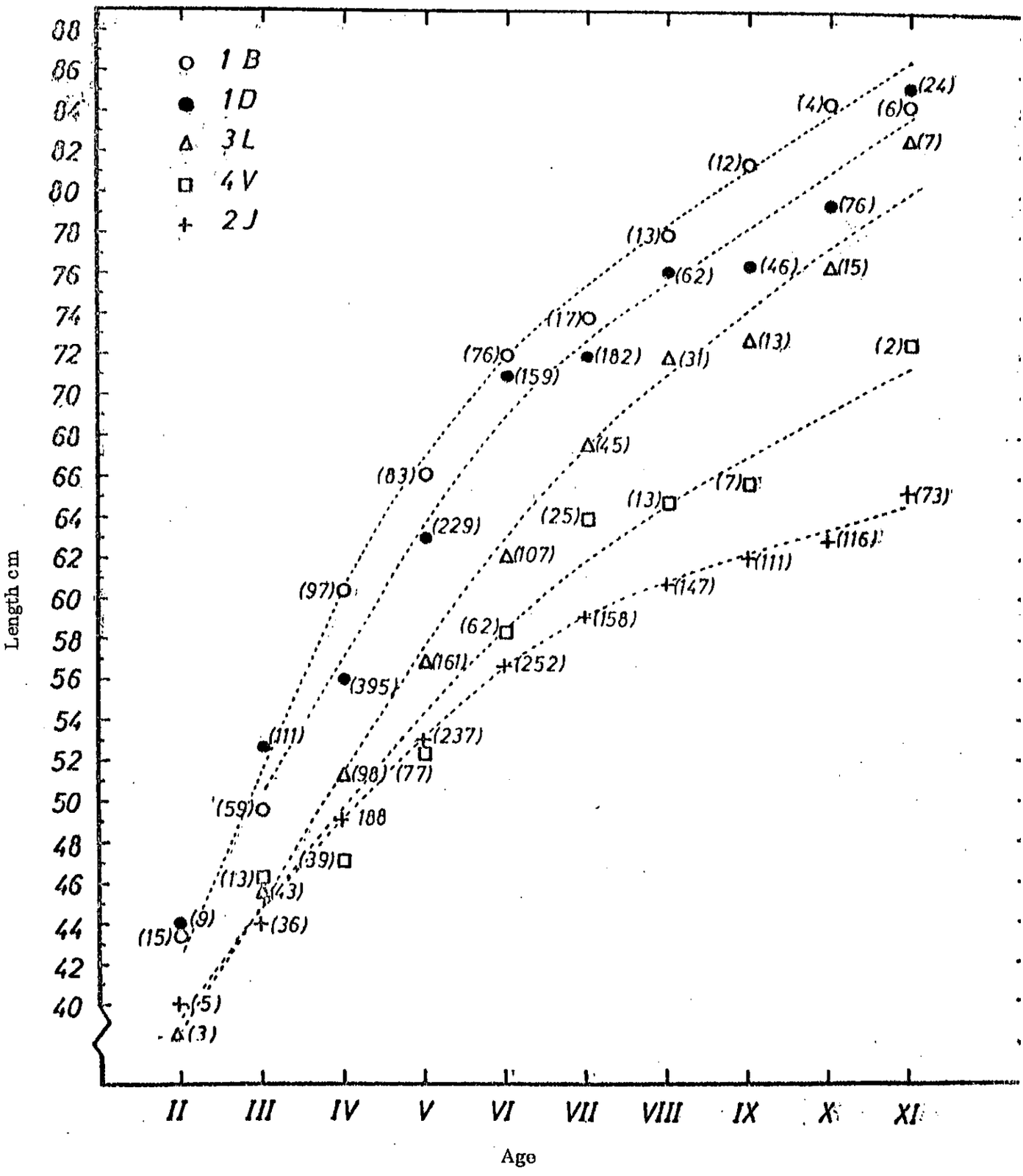


FIGURE 4 - GROWTH CURVES OF COD FROM DIVISIONS 1B, 1D, 3L, 4V AND 2J. THE CURVES ARE DRAWN FROM AVERAGES FOUND FOR COD FROM 1955 TO 1962.

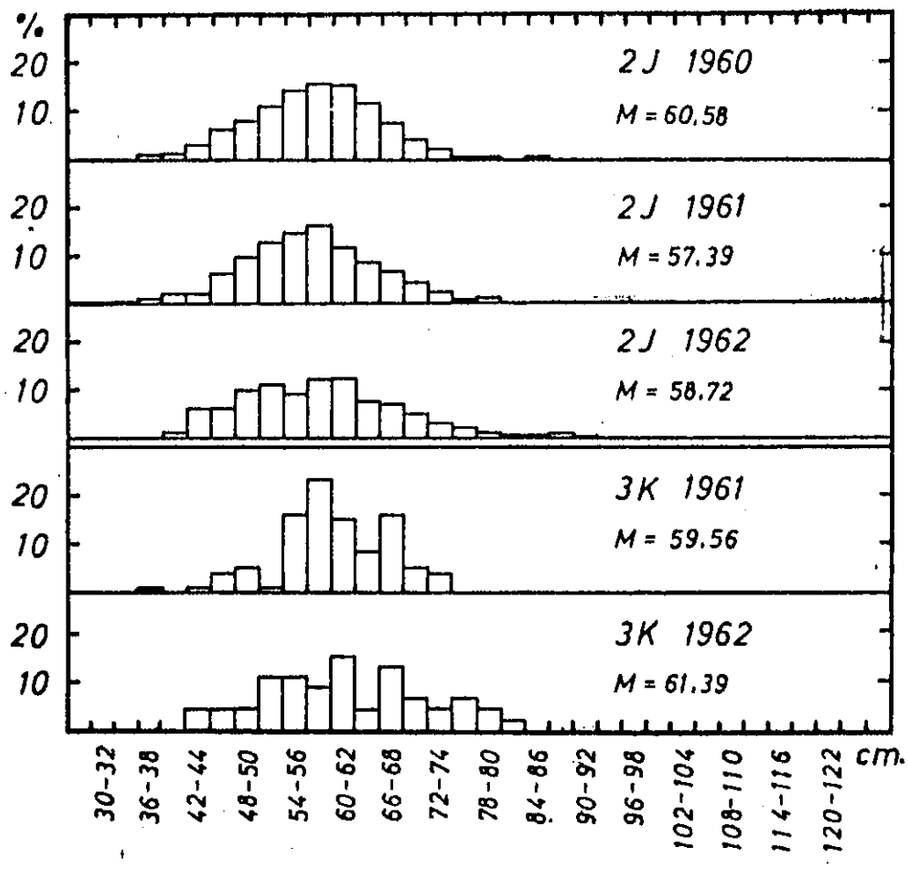


FIGURE 6 - RELATIVE LENGTH FREQUENCIES OF COD FOR DIVISIONS 2J (1960, 1961 AND 1962) AND 3K (1961, 1962).

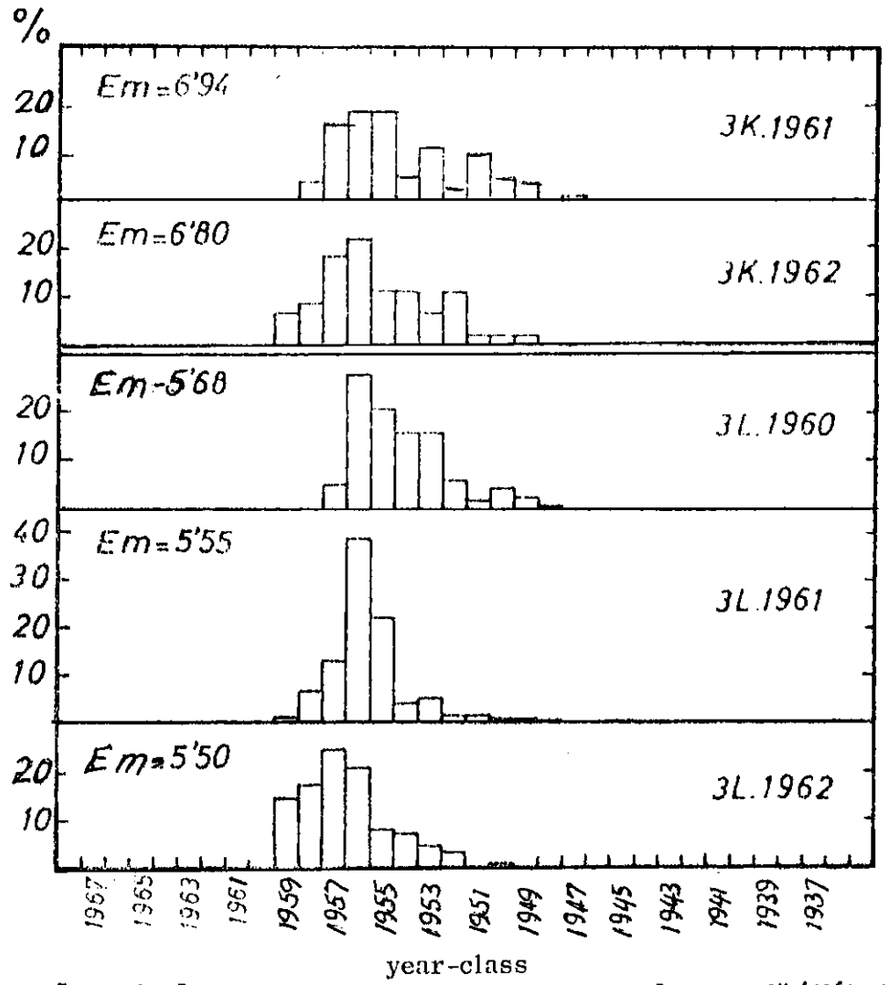


FIGURE 8 - RELATIVE YEAR-CLASS FREQUENCIES OF COD FOR DIVISIONS 3K (1961, 1962) AND 3L (1960, 1961 AND 1962). EM = AVERAGE AGE.

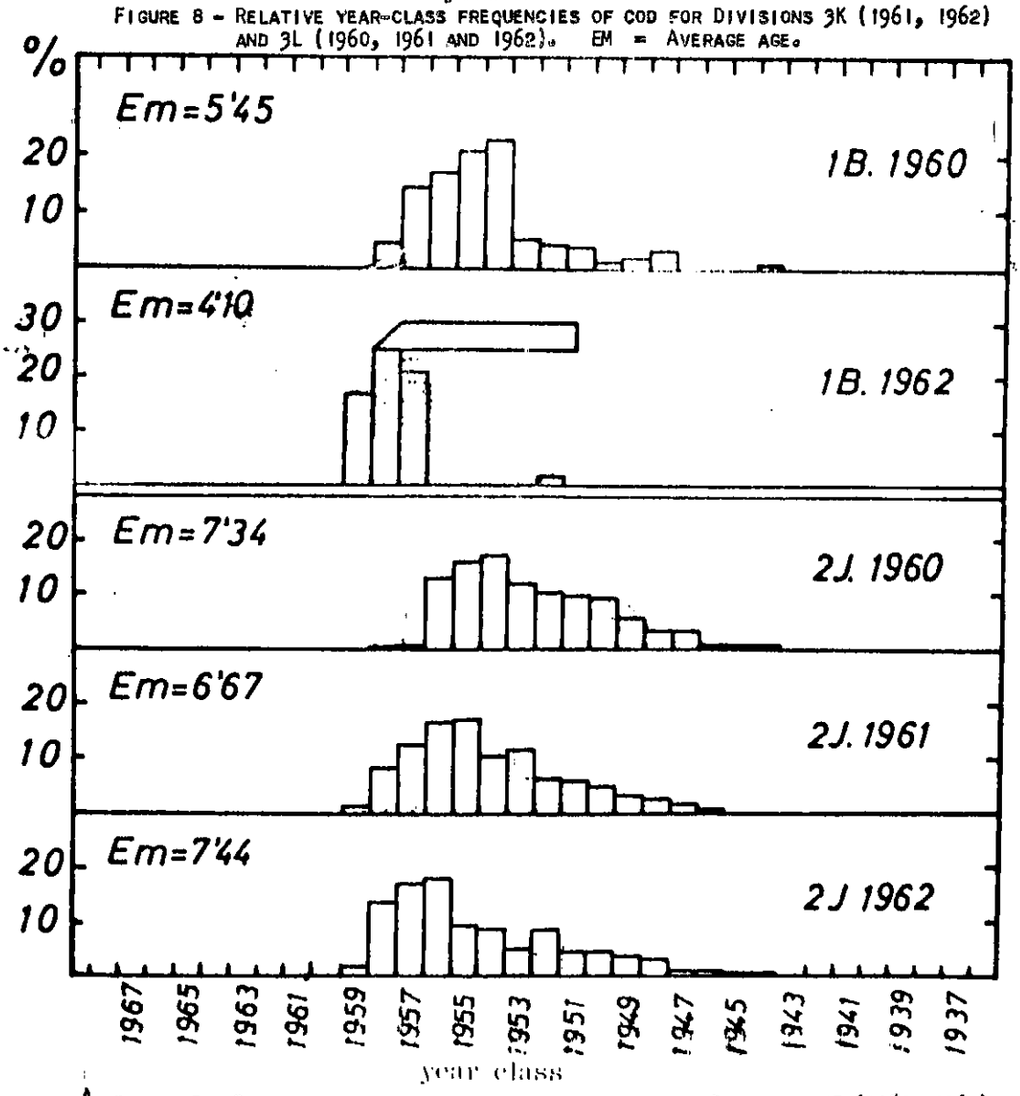


FIGURE 7 - RELATIVE YEAR-CLASS FREQUENCIES OF COD FOR DIVISIONS 1B (1960, 1962) AND 2J (1960, 1961 AND 1962). EM = AVERAGE AGE.