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Portuguese Research Report, 1960 [1/]

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The present paper summarizes the results of the samplings carried out on board Portuguese cod-fishing vessels in Subareas 1 (Greenland), 2 (Labrador), 3 (Newfoundland), and in Divisions 4R and 4Vn (Gulf of St. Lawrence and Nova Scotia).

The material collected includes data on size- and age-distribution, weights, sex ratio, stage of maturity and parasitization.

The gear used, the method of sampling and the technique of investigation are the same as in previous years (vide Portuguese Research Report, ICNAF Ann. Proc. Vol.7).

I. Cod (Gadus morhua L.), Subarea 1 (Greenland)

A total of ten samples, 1,500 specimens, were taken in Divisions 1F, 1E and 1D (April-May) from trawlers. Seven of these samples, 700 specimens, were aged by means of the otoliths. As in previous years, the samples were grouped by months and divisions (Table 1, Fig. 1)

1. Age-distribution (Fig.1)

In Division 1F (April, Gr.A), the age-group VII predominates (480 °/oo), followed by VIII (135 °/oo); the remaining age-groups are less than 110°/oo.

In 1E (May, Gr. B) age-group IV predominates (365 °/oo), followed by VII (291 °/oo) and V (110 °/oo).

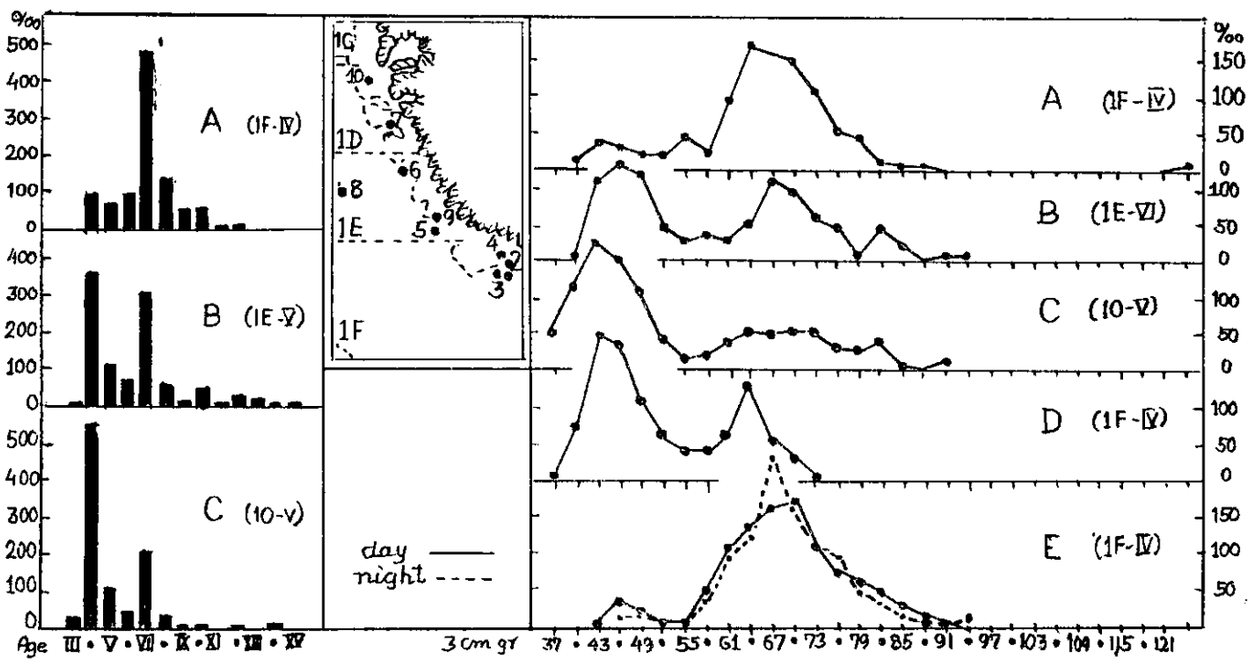

Figure 1 - Cod, Subarea 1, 1960. Age- and length-distribution (°/oo) of samples from trawlers. Left - Age; Centre - Position of samples; Right - Length.

1/ The tables giving the individual data will be published in Sampling Yearbook Vol.5 when not included in this paper.

Table 1 - Greenland, 1960. Sample groups studied (* samples without otoliths)

Sample Group	Sample No.	Division	Dates	Gear
A	1-3	1F	25/27-IV-60	Trawl
B	6-8-9	1E	1/5-V-60	"
C	7-10	1D	2/11-V-60	"
D*	4	1F	28-IV-60	"
E*	2	1F	26-IV-60	"

In 1D (May, Gr. C) age-group IV also predominates (550 °/oo), followed by VII (200 °/oo) and V (105 °/oo).

Summary: The 1953 year-class, which has been very abundant since 1957 (especially in the fishery of 1959), continues to yield an important share in the fisheries, and particularly in 1F in spring.

The 1956 year-class appears in 1960 for the first time in the catches, with its highest abundance in the catches from 1E and 1D.

The 1947 year-class is disappearing from the catches and the 1955 year-class is of some importance.

Year of	Year Class									
Capture	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
1955	+++	+	.	++	.	.	.	.	.	.
1956	+++	+	+	++	+	.	.	.	.	.
1957	+	.	++	+++	++	.	++	.	.	.
1958	+	.	.	+++	++	.	++	.	.	.
1959	+	.	.	.	.	++	+++	+	+	.
1960	.	.	.	.	+	+	+++	.	++	+++

2. Size-distribution (Fig.1)

In Division 1F, in April (Groups A, D*[1/] and E*) the size-distribution is somewhat different from group to group. In A and E*, which present similar characters, the lengths vary between 40 and 94 cm; in A the modal length is in the 64 cm-group, mean length 65.4 cm. In E* (day- and night-fishing) the length ranges from 43 to 94 cm, the length groups 67 and 70 cm predominate; the mean lengths for day- and night-samples are about the same: 68.9 and 68.5 cm. Sample Group D* is from about the same area, season and depth (130 m) as A and E*, nevertheless its length-composition differs: the length ranges from 37 to 73 cm with peaks at 43 and 64 cm, and a mean length of 51.7 cm, i.e. the cod are considerably smaller than in A and E*.

In 1E, May (Group B) the length varies between 40 and 94 cm; the curve has several peaks (at 46, 67 and 82 cm); the mean length is 59.9 cm.

In 1D, May (Group C) the length ranges from 40 to 91 cm with a peak off 43 cm; the mean length is 54.7 cm.

3. Growth (Fig.2)

Figure 2 presents the mean lengths for males and females of the various age-groups. The resulting growth curve reveals the more rapid growth of females; the inflexion point of the curves is for the 6th year.

1/ * - no otoliths collected

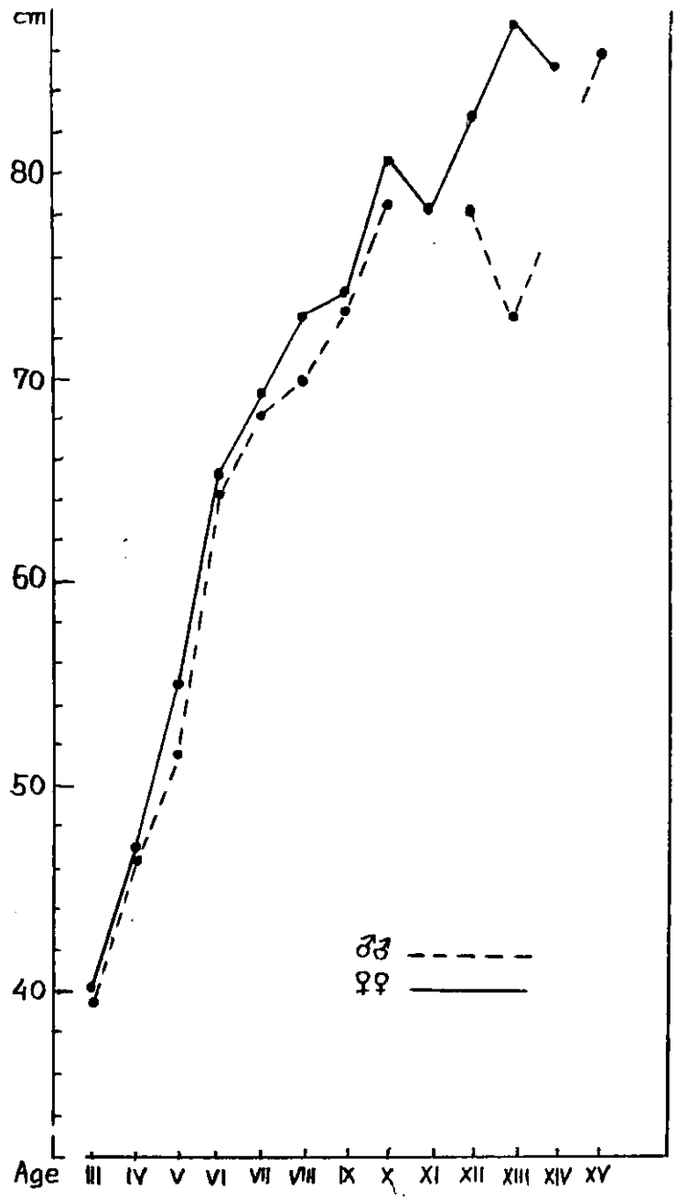

Figure 2 - Cod, Subarea 1, 1960. Growth curves for males and females.

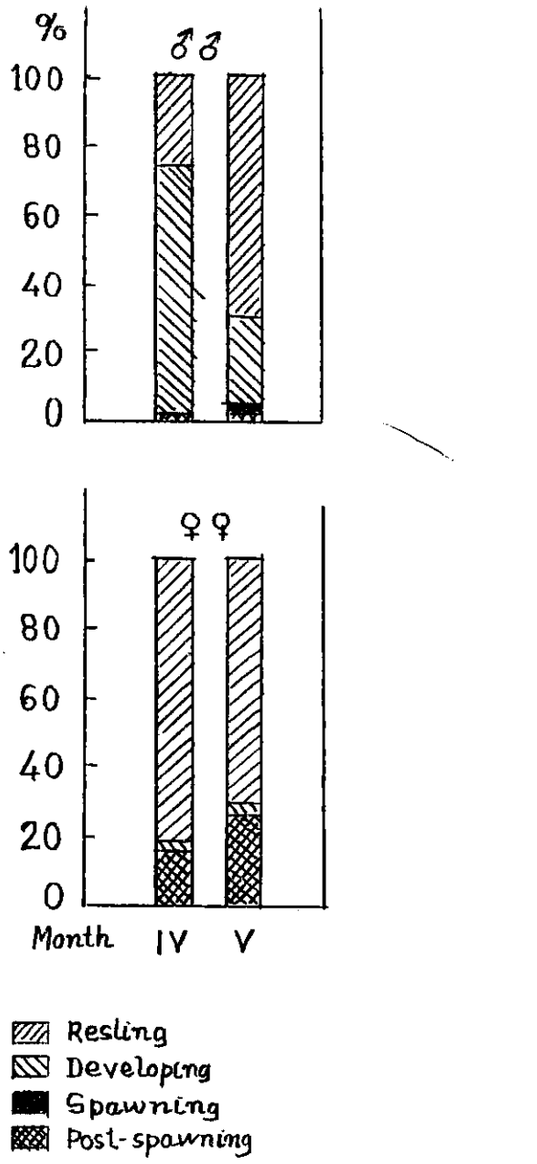

Figure 3 - Cod, Subarea 1, 1960. Percentage numbers of males and females of different stages of maturity in April and May.

4. Sex ratio

In Groups B and C the two sexes are evenly represented; in A the males predominate (55%); in E*, females predominate in both day and night samples (60%).

Table 2 - Greenland, 1960. Stage of maturity of gonads, determined by macroscopic observation; samples from April-May, Divisions 1F, 1E and 1D.

Stage of Maturity	April		May	
	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	26	82	69	71
Developing	73	0.1	26	2
Spawning	-	-	2	-
Post-Spawning	1	17	4	27
Observed	109	91	206	194

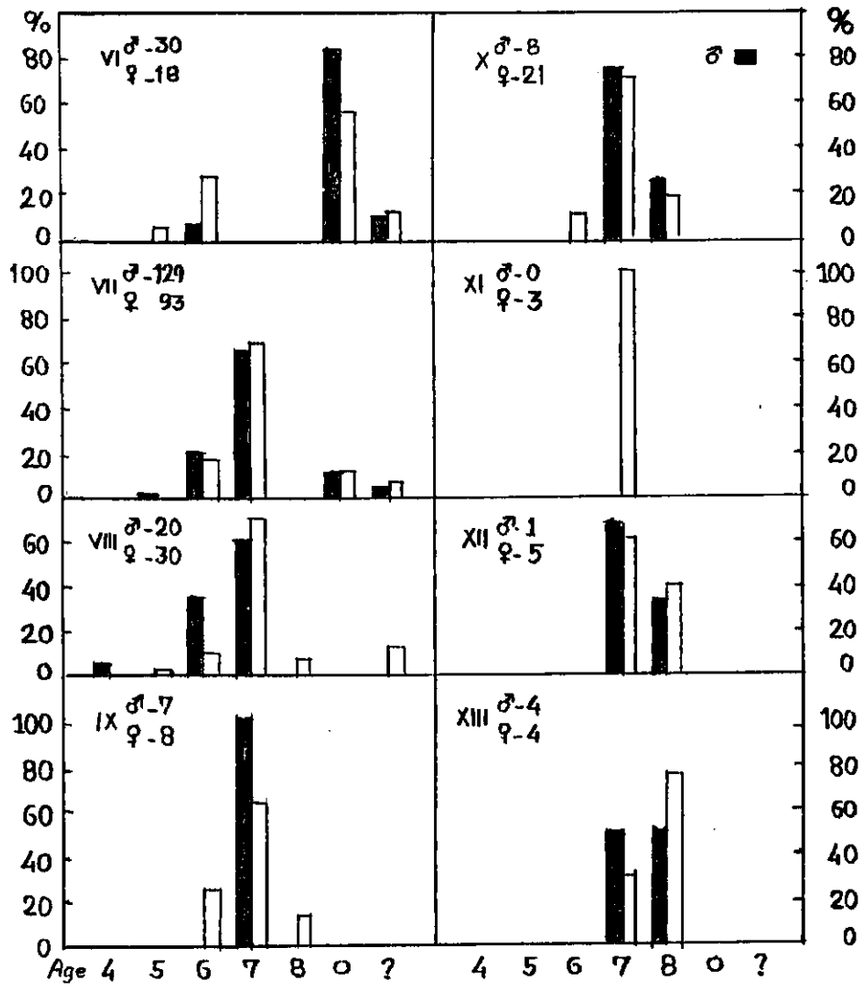

Figure 4 - Cod, Subarea 1, 1960. Percentage numbers of males (black) and females (white) of ages 4-8 spawning for the first time; age-groups VI-XIII,only, shown; o = no spawning mark.

5. Stages of Maturity (Table 2, Fig.3)

Males: In April the majority of the males (73%) are in the developing stage, 26% are in the resting stage, and only 1% are post-spawners. In May the number in the developing stage has decreased to 26%, whereas the number in the resting stage has increased to 69%; spawners and post-spawners are rare, 2% and 4% respectively.

Females: In April almost all (82%) are in the resting stage, the remaining (17%) are post-spawners. In May the number in the resting stage is smaller, 71%, whereas post-spawners now amount to 27%; scarcely 2% are in the developing stage.

6. First Maturity (Table 3, Fig.4)

First maturity is rarely reached in the 5th year, and in only a few cases in the 6th year. First maturity is most frequently reached in the 7th or 8th year, both for males and females.

There appears to be a trend towards earlier maturation in the more recent year-classes (since 1954, 1953 and 1952).

With the 8th year, all cod have reached maturity.

Table 3 - Greenland, 1960. Age at first maturity, males and females of age-groups VI-XIII, April-May, 1F, 1E and 1D.

Age-Group		♂♂ Age at First Maturity										♀♀ Age at First Maturity								
		IV	V	VI	VII	VIII	IX	e	?	Total		IV	V	VI	VII	VIII	IX	e	?	Total
VI	No.	-	-	2	-	-	-	25	3	30	No.	-	1	5	-	-	-	10	2	18
	%	-	-	7	-	-	-	83	10	100	%	-	6	28	-	-	-	56	11	101
VII	No.	-	1	25	84	-	-	14	5	129	No.	-	-	16	62	-	-	10	5	93
	%	-	1	19	65	-	-	11	4	100	%	-	-	17	67	-	-	11	5	100
VIII	No.	1	-	7	12	-	-	-	-	20	No.	-	1	3	21	2	-	-	3	30
	%	5	-	35	60	-	-	-	-	100	%	-	3	10	70	7	-	-	10	100
IX	No.	-	-	-	7	-	-	-	-	7	No.	-	-	2	5	1	-	-	-	8
	%	-	-	-	100	-	-	-	-	100	%	-	-	25	63	13	-	-	-	101
X	No.	-	-	-	6	2	-	-	-	8	No.	-	-	2	15	4	-	-	-	21
	%	-	-	-	75	25	-	-	-	100	%	-	-	10	71	19	-	-	-	100
XI	No.	-	-	-	-	-	-	-	-	-	No.	-	-	-	3	-	-	-	-	3
	%	-	-	-	-	-	-	-	-	-	%	-	-	-	100	-	-	-	-	100
XII	No.	-	-	-	2	1	-	-	-	3	No.	-	-	-	3	2	-	-	-	5
	%	-	-	-	67	33	-	-	-	100	%	-	-	-	60	40	-	-	-	100
XIII	No.	-	-	-	2	2	-	-	-	4	No.	-	-	-	1	3	-	-	-	4
	%	-	-	-	50	50	-	-	-	100	%	-	-	-	25	75	-	-	-	100

II. Cod (Gadus morhua L.) in Subarea 2 (Labrador)

A total of 49 samples from trawlers was collected in 2J and 2H (May through November), including about 8,000 cod; for 26 of these samples, 2,600 specimens, age-readings were carried out by means of otoliths. The grouping of the samples by division and month appears from Table 4 and Figure 5.

Table 4 - Labrador, 1960. Sample groups studied.

Sample Group	Sample No.	Division	Dates	Gear
A	1	2J	29-V-60	Trawl
B	2-4-7-10-12	2J	1/12-VI-60	"
C	13-14-16-18-22-25-26	2J	8/29-VIII-60	"
D	29-31-34-35	2J	1/21-IX-60	"
E	37-38-40-41	2H	24/28-IX-60	"
F	42	2J	4-X-60	"
G	43-44-46-48	2J	9/24-XI-60	"
H	3-9	2J	2/9-VI-60	"
I	15-17-20-23-24	2J	11/22-VIII-60	"
J	30	2J	2-IX-60	"
L	39	2H	26-IX-60	"

1. Age-distribution (Fig.5)

a. First Cruise (May-June)

In 2J, May (Group A) the age-group X predominates (200 °/oo), followed by VIII, IX and VII (160, 130, 110 °/oo); Group VI accounts for 100 °/oo, and XIII (which has been fairly abundant for years) for 80 °/oo.

Age-group VII predominates in June (Group B) with 186 °/oo, followed by IX and VIII (about 130 °/oo) and VI and X (about 110 °/oo).

b. Second Cruise (August-November)

In 2J, August (Gr. C) age-groups V to X predominate: VII with 166 °/oo, the others with about 120-140 °/oo.

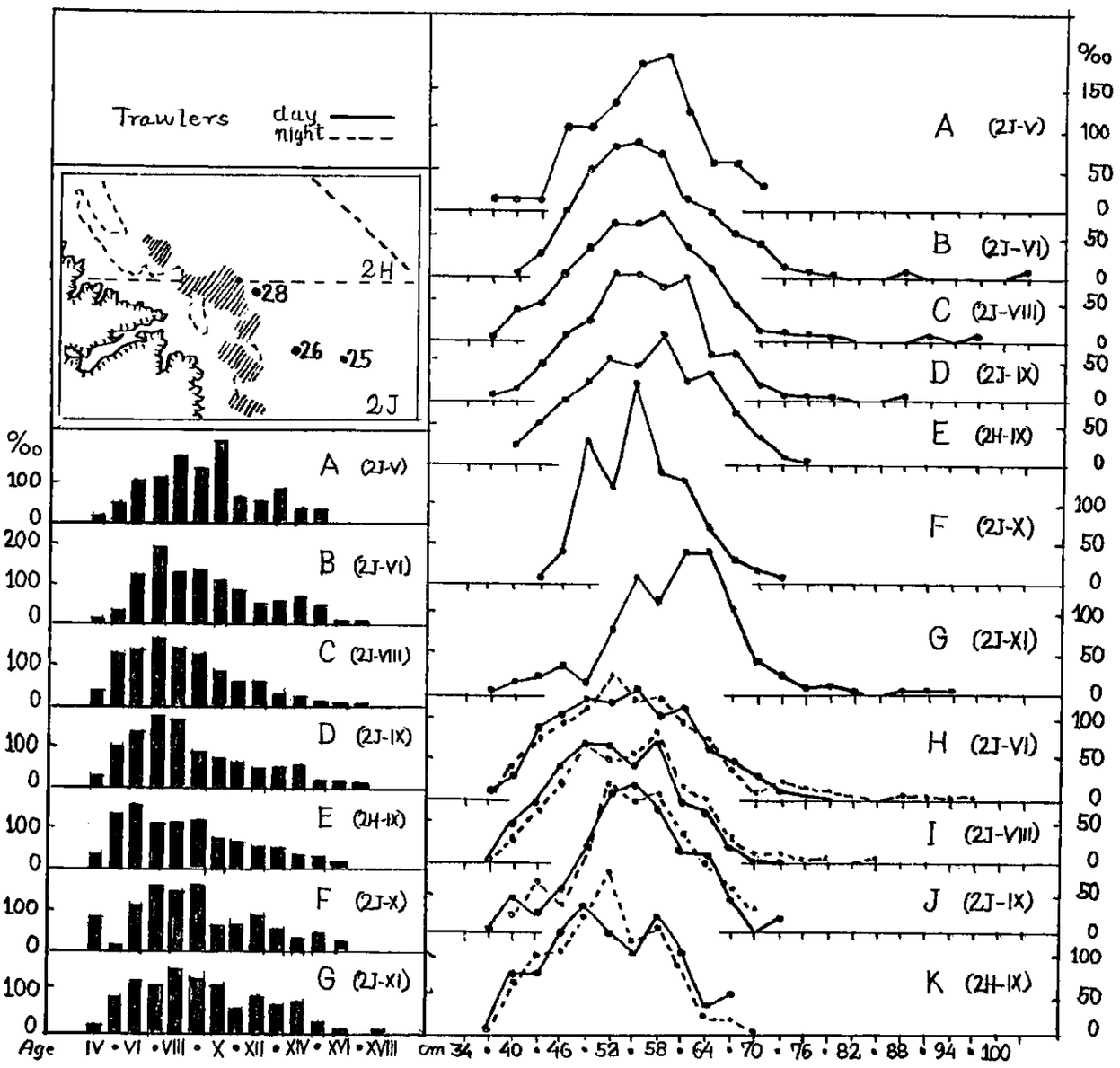

Figure 5 - Cod, Subarea 2, 1960. Age- and length-distribution (°/oo) of samples from trawlers. Left above - position of sample; Left below - age; Right - length.

In September (Gr. D) the age-groups VII and VIII (176 and 160 °/oo) and V and VI (100 and 133 °/oo) predominate; the remaining groups are less abundant, below 100 °/oo.

In October and November (Gr. F and S) the case is similar, with a preponderance of the following age groups: VI - 110-128 °/oo; VII - 160-118°/oo; VIII - 140-153 °/oo; and IX - 160-133 °/oo. It is to be noted that age-group V, which is very scarce (10%) in October, reappears in November, with 85 °/oo. In this month age-group X is also better represented, 110 °/oo compared to only 60 °/oo in October.

In 2H, September (Gr. E) the younger cod appear to be more abundant: VI-Gr. - 157 °/oo and V-Gr. - 139 °/oo. Groups VII, VIII and IX account each for ca. 113 °/oo.

Summary: As in 1955-58, this subarea continues to be characterized by the absence of strongly dominant year-classes. The 1953, 1952 and 1951 year-classes are the best represented, followed by 1955 and 1954. The 1950 year-class, which predominated in 1957 and 1958, is the richest in May, but then it decreases during the summer, being again better represented in November.

2. Size-distribution (Fig.5)

a. First Cruise

In 2J, May-June (Gr. A and B) the size-distribution is fairly even, with lengths between 37 and 103 cm. The peaks of the curve are at 58 and 55 cm corresponding to mean lengths of 55.7 and 54.8 cm.

In sample group H* (day and night fishing) the predominating lengths are a little lower (55 and 52 cm; mean length 55.0 cm).

b. Second Cruise

In 2J, August-September (Gr. C, I*; D, J*) the size-distribution is also fairly regular; in August ranging from 37 to 97 cm, with peaks at 52-58 cm, and a mean length of 55.2 cm (C); in I* the average length is a little lower (day - 53.4 cm, night - 54.1 cm).

In September (D, J*) the range of lengths is between 37 and 88 cm with peaks at 52 and 55 cm; the average lengths are: D - 55.6 cm, J* (day) - 55.9 cm, and J* (night) - 55.4 cm.

In October-November (F and G) the size variation is from 37 to 94 cm; the distribution is less regular than in the previous samples, the peaks are at 55, 49 and 61 cm and the mean length is about 60.5 cm.

In 2H, September (E, K*) the size-distribution varies between 37 and 76 cm; the curve presents several peaks: 58, 49 and 52 cm. The mean lengths are 55.9 cm, in another sample only 52.5 cm (day) and 51.7 cm (night).

3. Growth (Fig.6)

Figure 6 summarizes the mean lengths of males and females by age-groups for 2J and 2H. The growth is virtually the same as in previous years and shows a more rapid growth for females; the inflexion point of the curves is at the 6th year.

4. Sex ratio

The sex ratio shows, in general, a preponderance of females (521-610 °/oo); in Gr.A, May, 2J, however, the males predominate (550 °/oo).

5. Stages of Maturity (Table 5, Fig.7)

Males: In May-June almost all males are either in the developing stage (49-81%) or in the resting stage (47-51%). In June a few spawners appear (12%) and still fewer post-spawners (4-6%). August-November reveals a decrease in the number of males in the resting stage (26-8%) and an increase of the developing stage (73-92%). Spawners are very rare (0.6%), post-spawners rare (0.3-6%).

Females: In May-June resting stages (70-61%) and post-spawners (25-36%) are numerous, and few cod (7-3%) are in the developing stage.

In August-November post-spawners decrease from 51 to 7%, while cod in the developing stage increase (1-59%); cod in the resting stage change from 72 to 34%

6. Age at First Maturity (Table 6, Fig.8)

Males and females rarely attain maturity in the 4th and 5th year. In the 6th year a somewhat greater number reach maturity, but it is only in the 7th and 8th years that the largest number become mature for the first time.

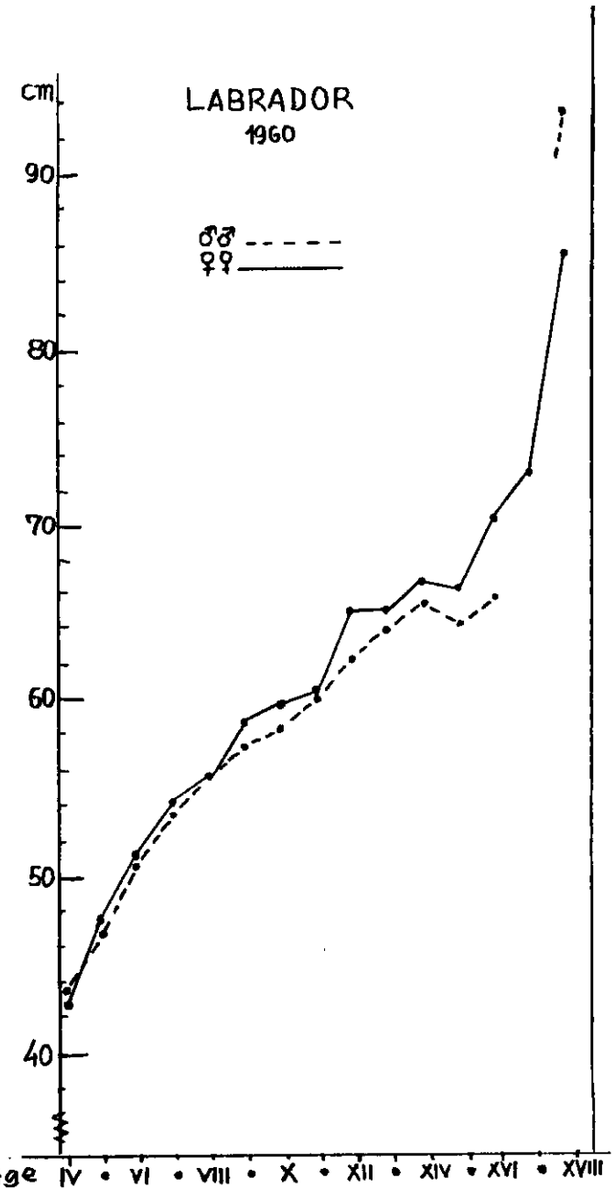

Figure 6 - Cod, Subarea 2, 1960. Growth curves for males and females.

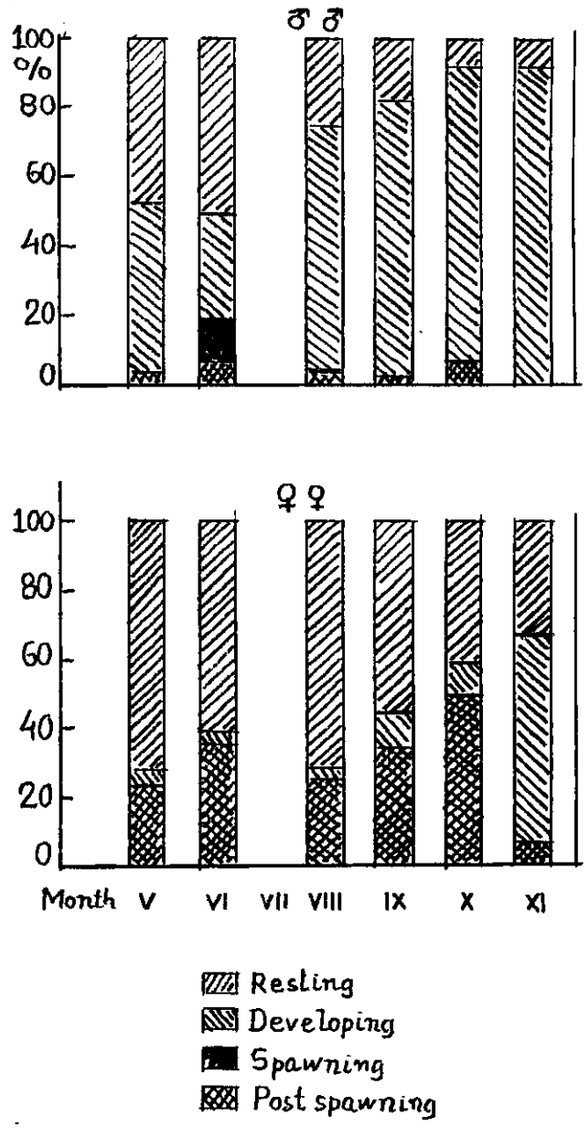

Figure 7 - Cod, Subarea 2, 1960. Percentage numbers of males and females of different stages of maturity, May through Nov.

Table 5 - Labrador, 1960. Stage of maturity of gonads, determined by macroscopic observation; samples from May-November, 2J and 2H.

	May		June		August		September		October		November	
Stage of Maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	47.2	70.4	51.0	60.6	26.0	72.0	18.1	54.9	7.8	40.8	7.8	33.5
Developing	49.1	4.6	30.9	2.9	73.0	0.8	80.8	9.5	86.3	8.2	92.1	59.2
Spawning	-	-	11.8	-	0.6	-	-	-	-	-	-	-
Post-Spawning	3.6	25.0	6.2	36.4	0.3	27.3	1.1	35.6	5.9	51.0	-	7.3
No. of Obs.	55	44	194	305	307	389	354	441	51	49	191	206

7. Weights

Data on total weight, weight of livers, gonads and intestines, were collected from about 800 individuals. As the specimens considered are distributed over several months and include different stages of maturity, the total weight by size-classes is affected by the different weights of gonads. This case will be considered in detail in future studies.

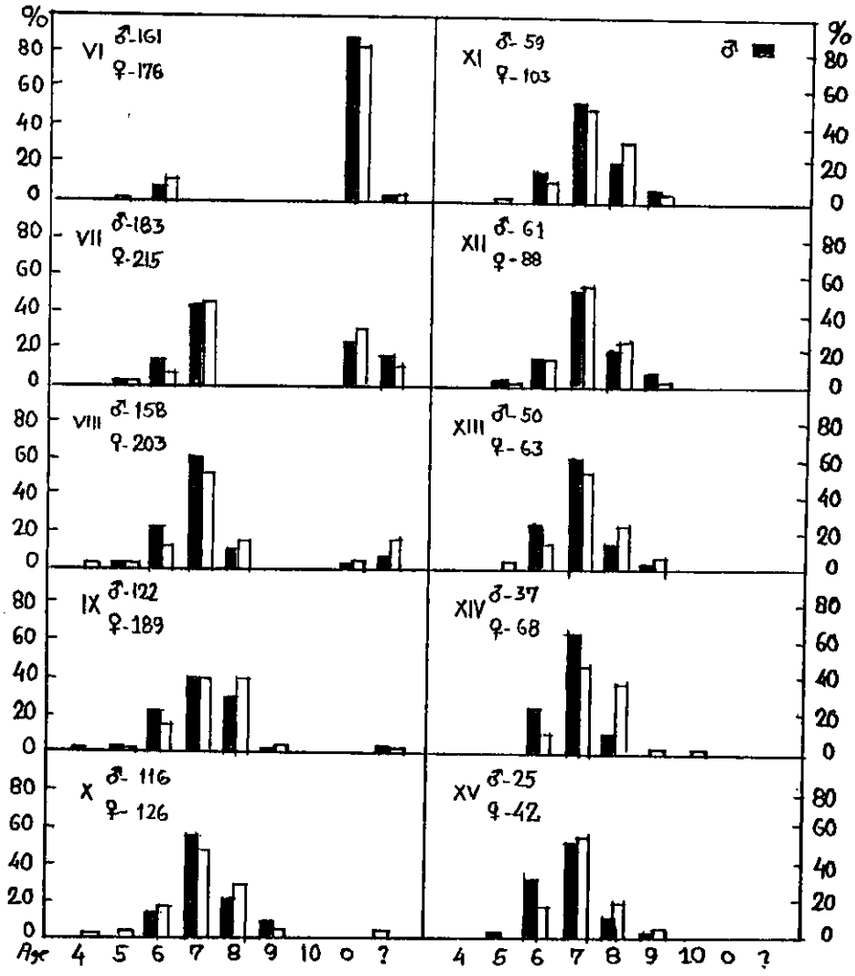

Figure 8 - Cod, Subarea 2, 1960. Percentage numbers of males (black) and females (white) of ages 4-10 spawning for the first time; Age-groups VI-XV,only, shown.
e = no spawning mark.

Table 6 - Labrador, 1960. Age at first maturity, males and females of age-groups VI-XV, May-November, 2J and 2H.

Age-Group		♂♂ Age at First Maturity										♀♀ Age at First Maturity									
		IV	V	VI	VII	VIII	IX	X	e	?	Totals	IV	V	VI	VII	VIII	IX	X	e	?	Totals
VI	No.	-	2	12	-	-	-	-	141	6	161	-	-	21	-	-	-	-	148	7	176
	%	-	1	8	-	-	-	-	88	4	101	-	-	12	-	-	-	-	84	4	100
VII	No.	-	3	25	81	-	-	-	46	28	183	-	4	21	96	-	-	-	69	25	215
	%	-	2	14	44	-	-	-	25	15	100	-	2	9	45	-	-	-	32	12	100
VIII	No.	-	1	34	94	15	-	-	4	10	158	1	1	24	106	30	-	-	8	33	203
	%	-	1	22	60	10	-	-	3	6	102	1	1	12	52	15	-	-	4	16	101
IX	No.	1	5	27	49	37	1	-	-	2	122	-	1	29	75	75	7	-	-	2	189
	%	1	4	22	40	30	1	-	-	2	100	-	1	15	40	40	4	-	-	1	101
X	No.	-	-	16	62	26	9	-	-	3	116	1	2	20	60	37	6	-	-	-	126
	%	-	-	14	54	22	8	-	-	3	101	1	2	16	48	29	5	-	-	-	101
XI	No.	-	1	10	31	13	4	-	-		59	-	-	12	51	35	5	-	-	-	103
	%	-	2	17	53	22	7	-	-		101	-	-	12	50	34	5	-	-	-	101
XII	No.	-	2	9	33	12	5	-	-		61	-	2	13	48	22	3	-	-	-	88
	%	-	3	15	54	20	8	-	-		100	-	2	15	55	25	3	-	-	-	100
XIII	No.	-	-	11	31	7	1	-	-		56	-	1	9	34	15	4	-	-	-	63
	%	-	-	22	62	14	2	-	-		100	-	2	14	54	24	6	-	-	-	100
XIV	No.	-	-	9	24	4	-	-	-		37	-	-	8	32	26	1	1	-	-	68
	%	-	-	24	65	11	-	-	-		100	-	-	12	47	38	2	2	-	-	101
XV	No.	-	1	8	13	3	1	-	-		25	-	-	8	23	9	2	-	-	-	42
	%	-	4	32	52	12	4	-	-		104	-	-	19	55	21	5	-	-	-	100

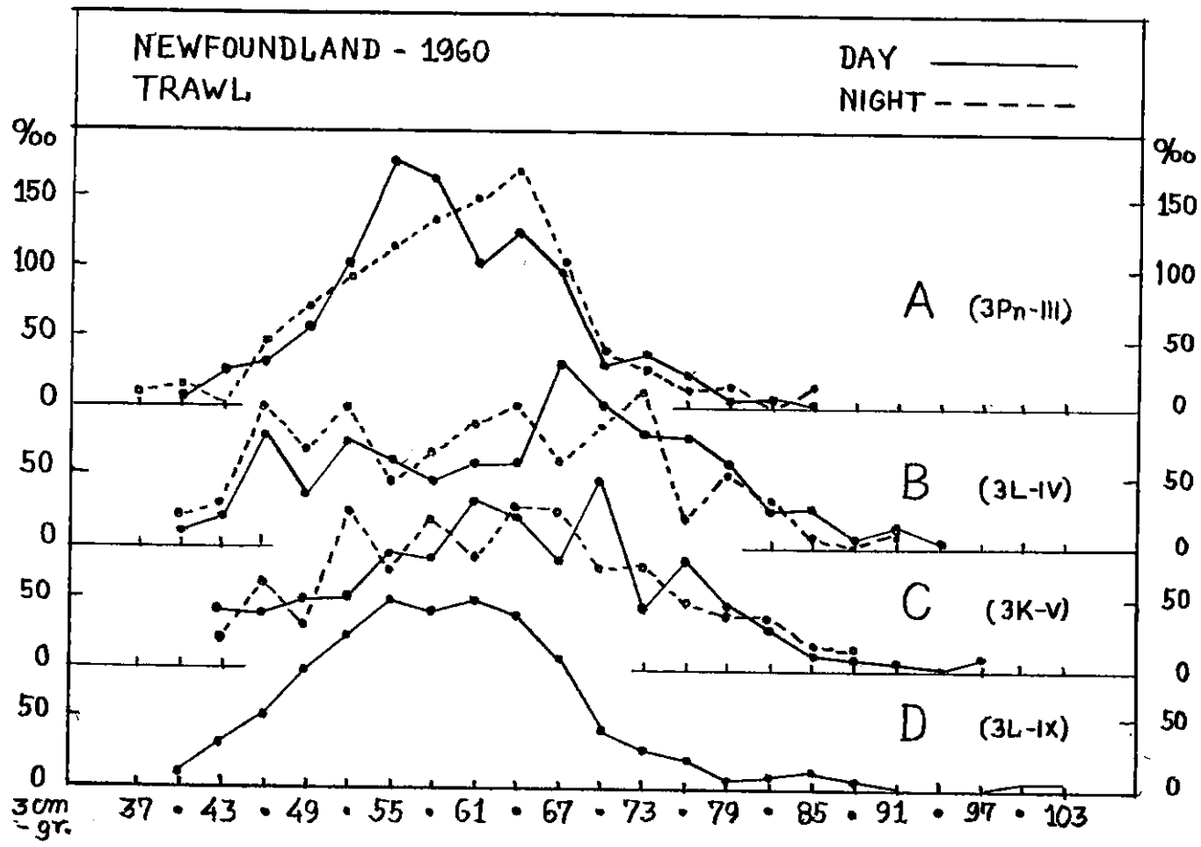

Figure 9 - Cod, Subarea 3, 1960. Length-distribution curves.

Table 7 - Subarea 3, Newfoundland, 1960. Sample groups studied. (*samples without otoliths)

Sample Gr.	Sample No.	Division	Dates	Gear
A*	5	3Pn	20-III-60	Trawl
B*	8	3L	13-IV-60	"
C	16	3K	26-V-60	"
D*	35	3L	2-XI-60	"

III. Length-distribution of cod (Gadus morhua L.) in Subarea 3 (Newfoundland)

The investigation includes 37 samples with 4,700 specimens (see Table 1) from trawlers. Only 4 of these samples (1,400 individuals) from 3Pn, 3L and 3K are considered here (Table 7, Fig.9)

In 3Pn, March, (Gr.A*) the lengths range from 37 to 85 cm. The length curve from the day samples is bimodal (55 and 64 cm), with a mean length of 59.1 cm; the curve for the night samples is more even with a peak at 64 cm and a mean length of 59.7 cm.

In 3L, April, (Gr.B*) the lengths vary from 40-94 cm in day samples and from 40-91 cm in the night samples; both curves show several peaks: day - 67, 52 and 46 cm; night - 73, 64, 52 and 46 cm. The mean length is 64.0 cm (day) and 61.7 cm (night). In November (Gr.D*) the lengths vary from 40 to 88 cm. The curve is fairly regular with a preponderance of the 55 and 61 cm groups, and a mean length of 59.2 cm.

In 3K, May, (Gr.C*) the lengths range between 43 and 97 cm; the curves are rather irregular, with several peaks: 70, 61, 76 cm (day) and 52, 64, 58 cm (night); the mean lengths are 63.0 cm (day) and 59.2 cm (night).

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