INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 963
(D. a .. 61)

Document No. 25

ANNUAL MEETING - JUNE 1962

Portuguese Research Report, 1961

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The present paper provides a summary of the sampling operations carried out on board the Portuguese cod trawlers during the 1961 fishery in Subareas 2 (Labrador), 3 (Newfoundland) and 4Vn, 4R and 4T (Nova Scotia, Gulf of St. Lawrence).

The operations include: size- and age composition, observation of weight, sex ratio, stage of maturity and first spawning.

The methods used for the sampling and the study are the same as in previous years (vide Portuguese Research Report, Annual Proceedings Vol.7).[1)]

I. Observations on Cod (Gadus morhua L.) in Subarea 4, 1961.

Nine samples, 1,750 individuals, were collected from a trawler. 600 otoliths were collected for age determinations. The samples were grouped by divisions and months of capture as far as it was possible (Table 1, Figure 1).[2)]

1. Age-distribution (Fig.1)

Division 4R (March)

Group A. The following age-groups predominate: V - 420 °/oo; VI - 215 °/oo; VII - 175 °/oo; and IV - 125 °/oo. The remaining age-groups are represented by less than 100 °/oo, the age-group VIII with only 40 °/oo.

Group B. This group, although from the same division and dates, presents a differing distribution, with the following dominance of age-groups: VIII - 220 °/oo; V - 210°/oo; VII - 170 °/oo; V - 140 °/oo; and IX - 100 °/oo. The samples in this group are from greater depth than those in Group A, and the larger individual size is to be noted (vide the curves in Fig.1).

Division 4Vn

Sample Group D, from March, shows the following dominance of age-groups: V - 370 °/oo; VI - 310 °/oo; VI - 310 °/oo; VII - 140 °/oo; and IV - 110 °/oo.

Sample Group E, from April, presents a distribution similar to that found in March, viz: VI - 380 °/oo; V - 230 °/oo; and VII - 210 °/oo. The age-group IV is represented by only 80 °/oo.

Division 4T

The only sample from this division is from April (Sample Group G); the following age-groups predominate: VII - 240 °/oo; V - 200 °/oo; VI - 190 °/oo; and VIII - 140 °/oo. The age-group IV, which was fairly well represented in the divisions previously mentioned, is almost non-existent here - only 30 °/oo.

Summary. The predominating year-classes in the samples investigated are, in general, the following: 1954, 1955 and 1956. The two first-mentioned have been the predominating year-classes since 1959. The 1956 year-class maintains its place since 1960 when it appeared for the first time. The 1953 year-class, which was very abundant in the

1) The tables giving the data on which the figures in this paper are based will appear in the Sampling Yearbook for 1961.

2) Figures appear throughout the text; tables are given at the end of this document commencing on page 10.

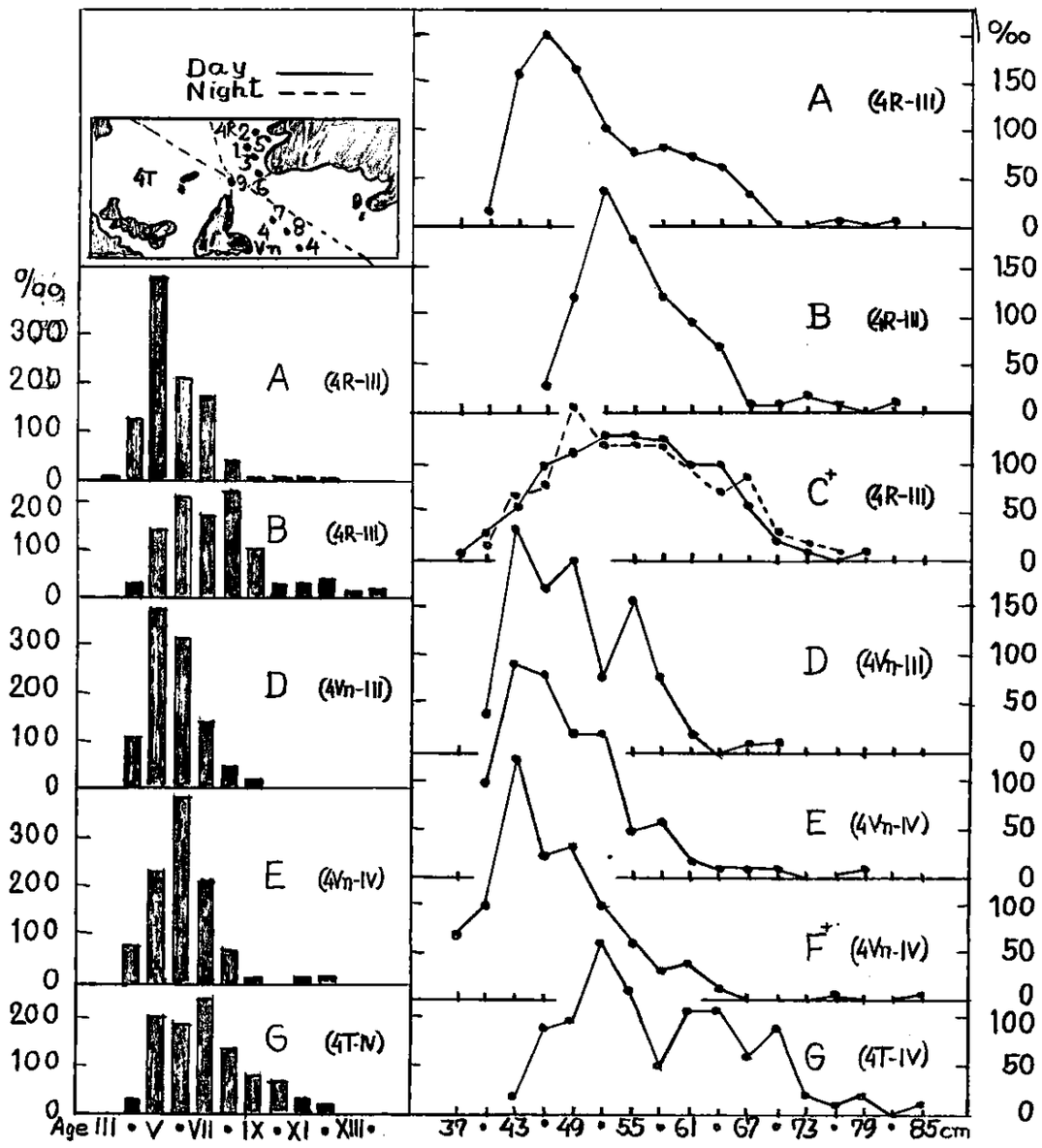

Figure 1 - Cod, Subarea 4. Trawl samples. Map of sample positions (left above), age-distribution (left below) and length distribution (right).

samples from 1960 is only sparsely represented this year; however, it predominates in the samples from 4R - March (Group B).[1)]

2. Length distribution (Fig.1)

Division 4R (March)

Group A. The range of length distribution is from 40-82 cm; the length curve is unimodal, with the peak off 46.0 cm; the mean length is 51.6 cm.

Group B. The length curve is unimodal with the peak at 52.0 cm; the distribution is limited to the classes 46 to 82 cm; the mean length is 56.5 cm.

Group C. The range of lengths varies in the day samples between 37.0 and 79.0 cm, with the peak off the classes 52.0 to 55.0 cm. The night samples show a length distribution between 40.0 and 79.0 cm; the curve is bimodal, with peaks off 49.0 and 67.0 cm; The mean length of the day samples is 55.3 cm, of the night samples 55.7 cm.

[1)]The abundance of the year-classes in the fisheries in this division in 1956, 1957 and 1958 appears from the Portuguese Research Report for 1958 (Annual Proceedings Vol.8).

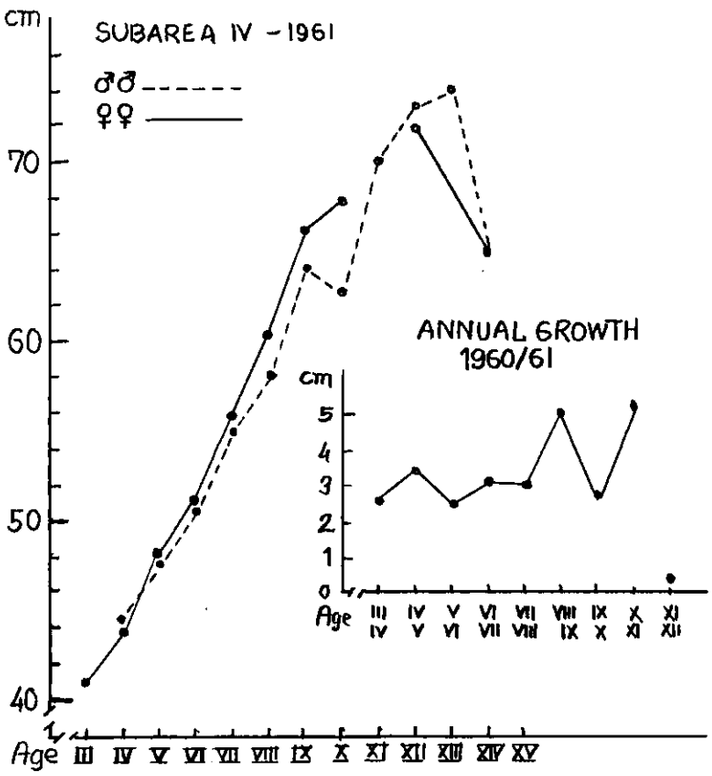

Figure 2 - Cod, Subarea 4. Mean lengths of age groups and annual growth.

Figure 3 - Cod, Subarea 4. Stage of Maturity.

Division 4Vn

Group D (March). The length distribution ranges between 40.0 and 70.0 cm. The curve is trimodal, with peaks offthe classes 43, 49 and 55 cm. The mean length is 49.3 cm.

Group E (April). The length curve is multimodal, with the highest peak off 43.0 cm. The range of lengths is from 40.0 to 79.0 cm. The mean length is 48.5 cm.

Group F (April). Also here the length curve is multimodal and the highest peak is also off 43.0 cm. The range of lengths runs from 37.0 to 85.0 cm. The mean length is 47.3 cm.

Division 4T (April)

The length curve is multimodal, with the highest peak off the class of 52 cm. The range of lengths is from 43.0 to 85.0 cm. The mean length of the sample is 51.0 cm.

3. Growth (Fig.2)

The mean lengths of males and females separately are shown combined for all the samples from Divisions 4R, 4Vn and 4T. The curves show the inflection point to be at the sixth year. The growth rate is a little higher for the females than for the males; from the ninth or tenth year a decrease in growth rate is observed.

4. Sex Ratio

The samples show in their totality a slight predominance of the males, accounting for 510-560 °/oo, except for sample group D where the two sexes are equally abundant.

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

Males. In March the majority are in the resting or the recovering stage (47%); 38% are in the developing stage and the remaining 15% are spawning. In April the number of males in the developing stage has increased to 49%; 26% are in the spawning stage and only 25% in the resting stage.

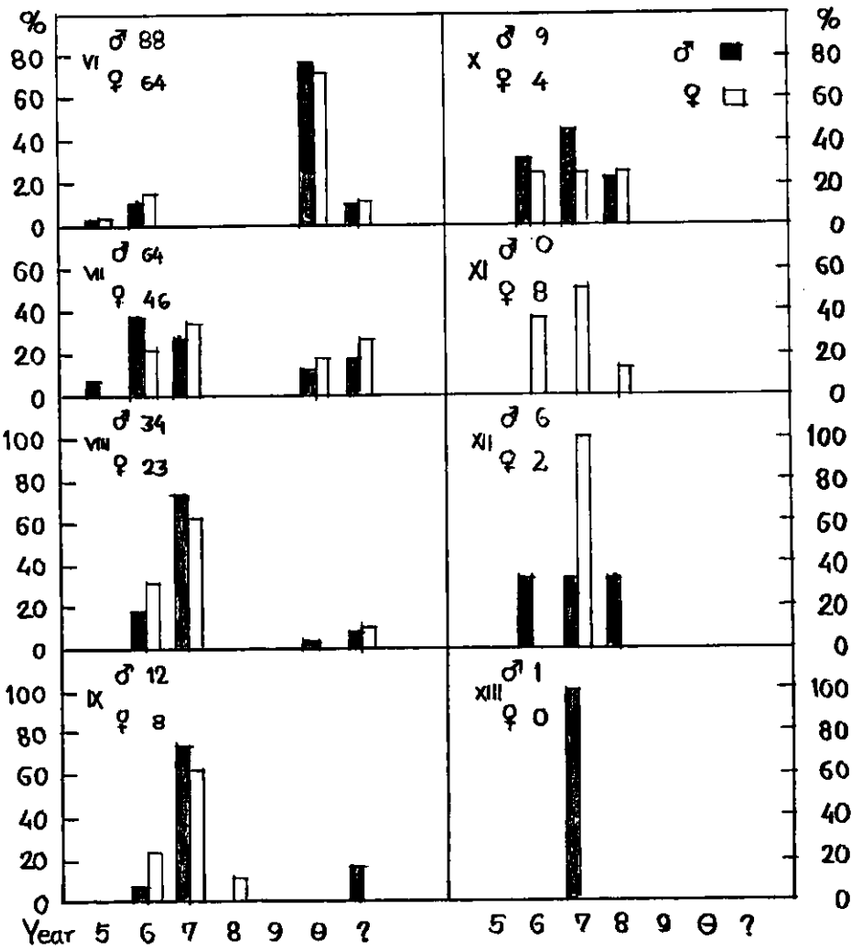

Figure 4 - Cod, Subarea 4. Age (5-9) at first maturity for males (black) and females (white) of the age-groups VI-XIII.

Females. In March 58% are in the resting stage, 41% in the developing stage and 1% are post-spawners. In April the distribution is similar: resting - 56%, developing - 42% and post-spawners - 2%.

6. Age at First Maturity (Table 4, Figure 4)

In connection with the age readings, the year in which the majority of the cod attain maturity for the first time was determined. The year of first maturity falls between ages 5 and 8, with age 7 as the most frequent.

II. Observations on Cod in the Newfoundland Region (Subarea 3).

A total of 54 samples (8,386 specimens) were collected from trawlers operating in Divisions 3K (Belle Isle), 3L (Grand Bank) and in 3Pn and 3M during the fishery in 1961 from the end of February to the end of November. In connection with the measurements, otoliths were collected from 4,400 cod; determinations of sex and maturity were carried out together with 3,986 measurements and 500 weighings.

Investigations on the amount of parasitization and on the specification of the species of parasites were carried out, but are not considered further in this report.

The samples were, in conformity with the adopted procedure, grouped according to division and month, except for samples showing a distinctly differing age composition. (Table 4).

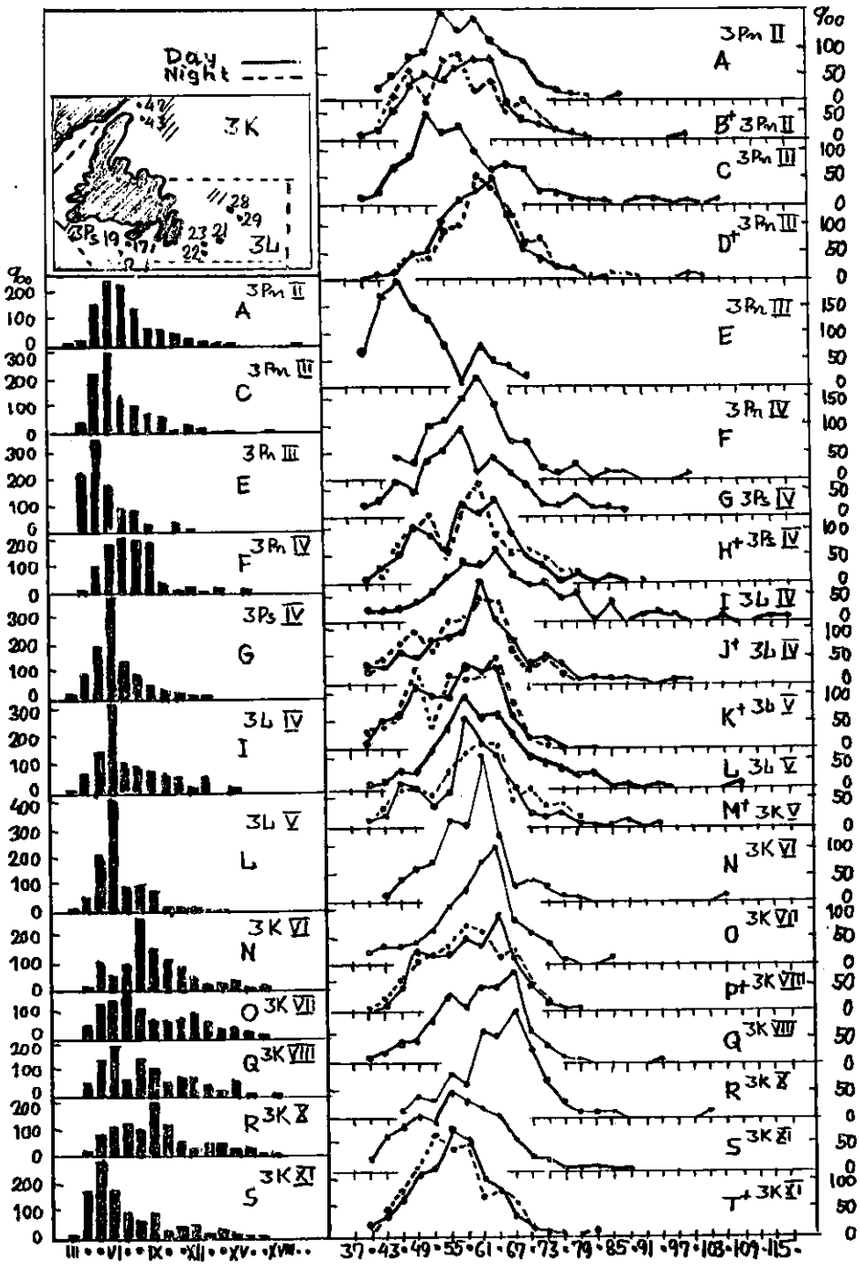

Figure 5 - Cod, Subarea 3. Map of sample positions (left above), age distribution (left below) and length distribution (right).

1. Age Distribution (Fig. 5)

The age was determined for 2,754 otoliths. This is the first time that it has been possible to compile such a high number from this subarea in the Portuguese research reports; until now only a summary has been given of the age of the stock in 3K (Belle Isle) for the years 1955/56 (Portuguese Research Report, Annual Proceedings Vol. 7).

The reading and interpretation of the cod otoliths from this subarea is difficult, and the results presented must be used with some reservation and may be revised later on.

First Cruise (February-June)

Division 3Pn, February - Group A, March - Group C. The age distribution is the same in these two groups; the prevailing age groups are: VI - 240 to 308 °/oo; VII - 223 to 134 °/oo; V - 157 to 217 °/oo; and VIII - 137 to 107 °/oo. In Group E from the same division and from March, younger fish are predominating: V - 350 °/oo; IV - 220 °/oo and VI - 180 °/oo. In Group F from April, the dominant age groups are: VII - 210 °/oo, VIII - 200 °/oo; VI - 180 °/oo; V - 100 °/oo; and IX - 90 °/oo.

Division 3Ps, April, Group G - predominating age groups: VI - 370 °/oo; V - 190 °/oo and VII - 140 °/oo.

Division 3L, Grand Bank, Group I, April. Predominating age groups: VI - 323 °/oo; V - 147 °/oo; and VII - 106 °/oo. Group L, May. Strong predominance of age group VI - 423 °/oo and V - 210 °/oo.

Division 3K, Belle Isle. Group N, June. Dominating age groups: VII - 263 °/oo; IX - 152 °/oo; X - 111 °/oo and V - 101 °/oo.

Second Cruise (July-November)

Division 3K. Group O (July). The most abundant age groups are: VII - 156 °/oo; VI - 136 °/oo; V - 116 °/oo; and VIII - 101 °/oo. Group Q (August). The dominating age groups are VI - 191 °/oo; VIII - 140 °/oo; V - 137 °/oo; and IX - 104 °/oo. Group R (October). The dominating age groups are: IX - 200 °/oo; VII - 120 °/oo; X - 120 °/oo; VI - 110 °/oo and VIII - 100 °/oo. Group S (November). The rather young age groups are predominating: V - 276 °/oo: VI - 172 °/oo and IV - 164 °/oo.

Summary for Subarea 3

No one single year-class can be pronounced as the predominating, but one notes a rather constant abundance of several year-classes: 1955, 1956, and also 1954. It is also to be noted that the older 1952 and 1953 year-classes are still present in Division 3K; also the young 1957 year-class is represented.

2. Length Distribution (Fig.5)

In addition to the samples from which otoliths were taken are eight further samples with length measurements. The general results of the study of the samples are:

In Groups A and C (Division 3Pn - February to March) the abundant cm-groups are: 52-55-58 and 61; this is contrary to the case in Group E from March, which presents a bimodal curve with peaks at 46 and 61 cm, corresponding to the dominating of the age-groups IV-V-VI in these samples.

In Group F (April) there is in the main only one peak off 61 cm, apparently in connection with the predominance of the age-groups VII-VIII-IX.

In Groups G, I and L (April-May) the larger length frequencies are found in the classes 58 and 61 cm (age-groups V-VI-VII).

In the samples from 3K a greater abundance of the age-groups above VII occur in connection with larger frequencies of the higher length classes; this is especially apparent in Groups Q and R (August-October) where the highest peaks are off 67 cm. However, cod of smaller sizes are also present, cm-classes 55 and 61. Group S from November includes mainly younger cod with peaks in the cm-classes 49 to 55.

The range of the lengths is from ca. 43 to 88 cm, reaching exceptionally 118 cm in one sample.

The samples show a slight prevalence of larger cod in day samples to night samples. In the length curves of these day samples the highest peaks are found in classes 58 and 64 cm, in the night samples, however, in classes 58-61 cm, in some cases even as low as 49 cm. In the day sample (T-3K-Nov.) the peak is off 55 cm.

3. Growth (Fig.6)

The average lengths of females and males by age groups are shown in Fig.6. The growth (all samples together) is about the same up to age VII; from that age and upwards, the females grow a little stronger. The point of inflection is at age V; in the curve for the males this point is at age VI.

From age VII the growth rate of males and females decreases; a kind of stop in the growth appears for the females between the XI and XII year, and for the males between the X and XI year. After these ages the growth again increases.

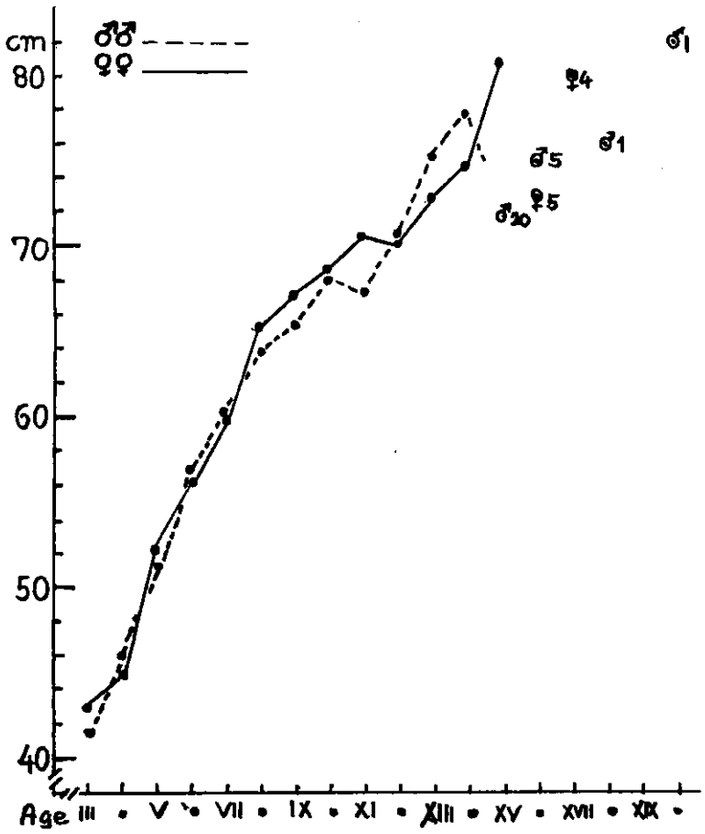

Figure 6 - Cod, Subarea 3. Mean lengths of age groups.

4. Sex Ratio

The males generally predominate in the samples (537-560 °/oo). Only in four of the groups in 3K (mainly in July-August) are the females more abundant than the males.

It appears that there are proportionately more females in day catches than in night catches.

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

Males. From February to June the majority are in the developing stage (37-76%), a rather high percentage (11-28%) are spawners; the remaining are in the resting stage, including immature and recovering individuals (12-33%), and in the post-spawning stage (2-3%). From July to November only 0.9% of the males were spawning; the majority (40-96%) were in the developing stage; 4-60% were in the resting stage, and in the sample from August 11.1% were post-spawners.

Females. Only few spawning females were observed, 0.6 to 3.4% between April and June. During the period of observation, February to November, 2-48% were post-spawners, the highest figures are from June, July and August; 18-76% were in the developing stage, the highest percentage was in February, with decreasing percentages until June. No females in the developing stage were observed in July-August, but again only in October-November (17-35%). From February to June 30-71% were in the resting stage, increasing to 51-73% in July to November.

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

The spawning zones were not very clear in the otoliths from Subarea 3. The first maturity was found to occur between age V and IX (exceptionally at age X), VII being the most common age.

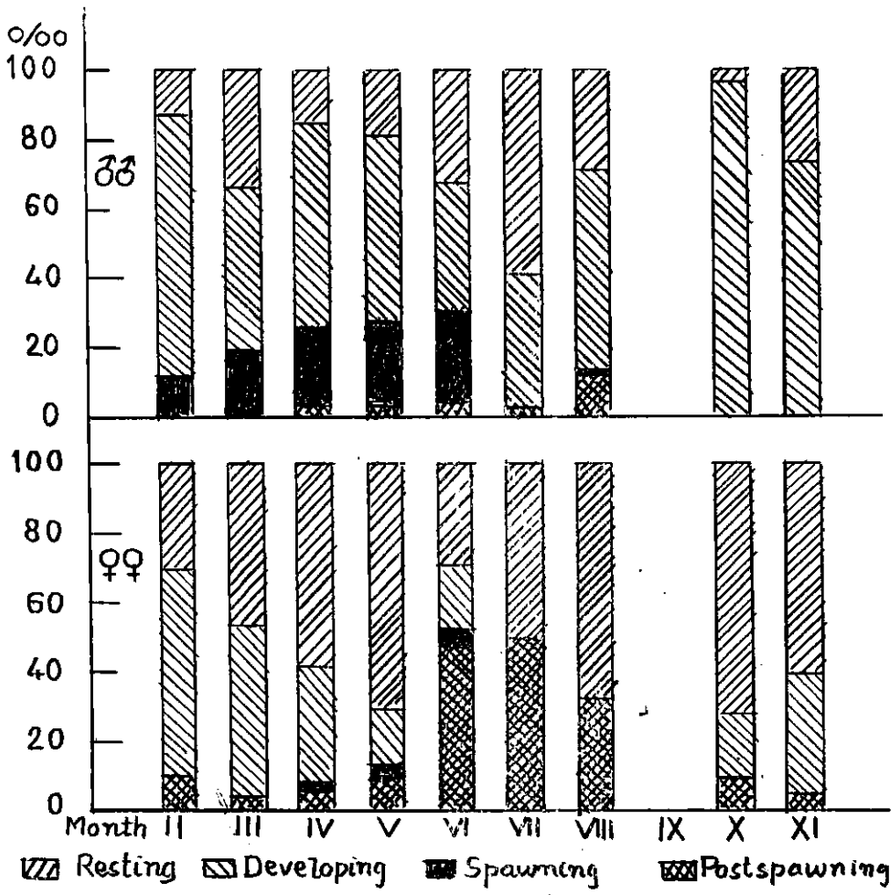

Figure 7 - Cod, Subarea 3. Stage of Maturity.

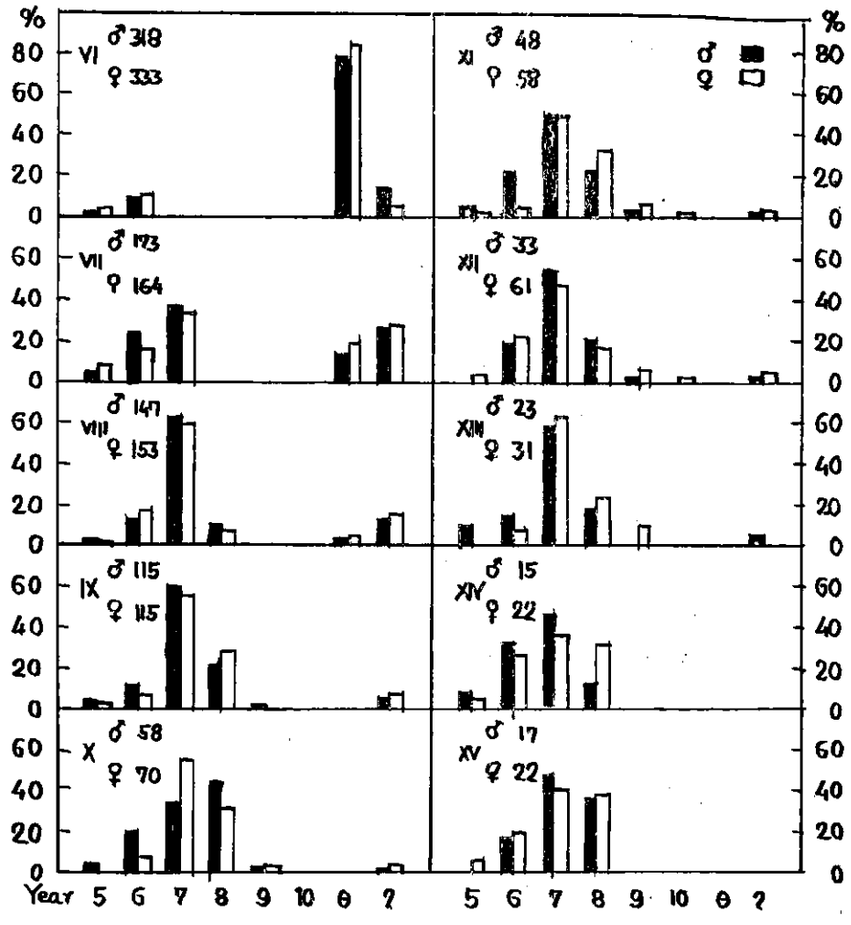

Figure 8 - Cod, Subarea 3. Age (5-10) at first maturity for males (black) and females (white) of age-groups VI-XV.

III. Observations on Cod off Labrador (Subarea 2)

A total of 40 samples were collected from trawlers. The grouping of the samples is shown in Table 7. For the present only seven samples (2,720 specimens) from Division 2J are considered.

1. Length Distribution (Fig. 8)

In Group A (May) the size distribution in the day samples ranges from 37 to 100 cm; the length curve is unimodal, with a peak at 61 cm; the mean length is 59.1 cm. The night samples do not present any appreciable difference from the day samples; the highest is in the 58 cm class, but a lower peak is present in the 46 cm class. The mean length is 59.1 cm as also in the day samples.

In Group B (September) the length curve for the day samples is trimodal, with peaks at 58-49 cm and 64 cm. The mean length is 57.2 cm. The curve for the night samples presents a clear predominance of the 58 cm class. The range of variation is from 37 to 85 cm.

In Group C (November) the day and night samples attain higher length frequencies in the classes 58 and 64 cm; this is especially pronounced in the night sample where the length class 58 cm reaches a percentage of 24.3.

IV. Weight Observations

Data on weight of fresh fish, of gonads, intestines and livers, were collected from cod from Subareas 2, 3 and 4. These data will be considered in another paper, giving mean values by size classes, together with a description of methods and of conditions of weighing.

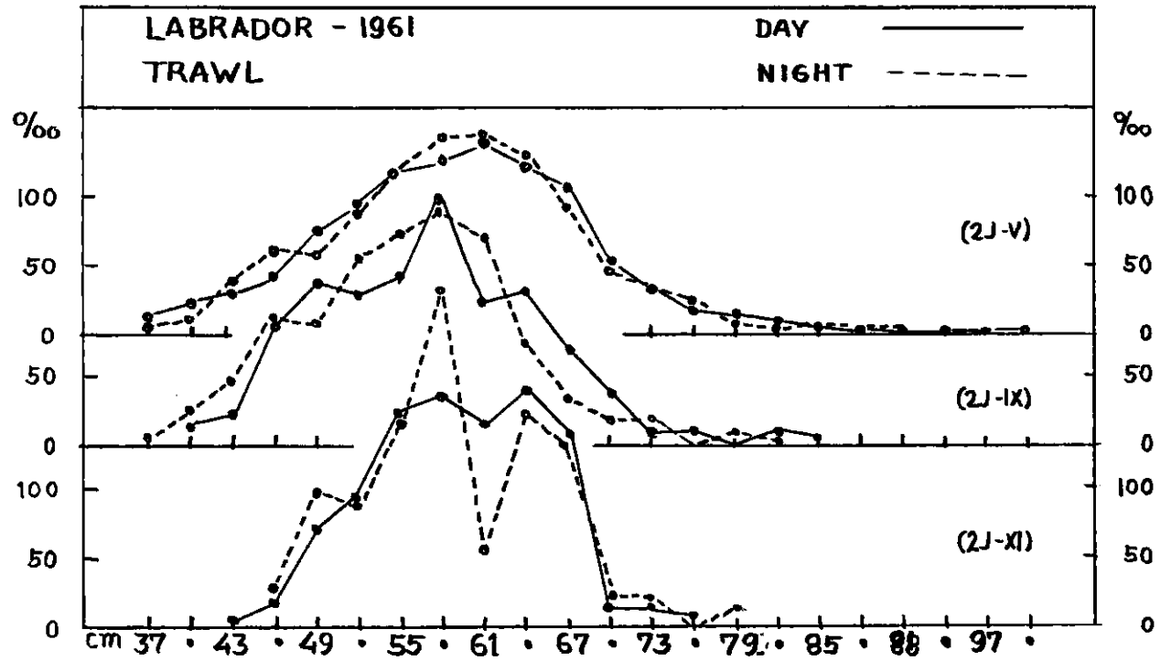

Fig. 9. Cod, Subarea 2. Length distribution

Sample gr.	Samples	Division	Dates
A	1-6	4R	11-31 Mar.61
B	3	4R	13 Mar.61
C*	2-5	4R	12-29 Mar.61
D	4	4VN	24 Mar.61
E	7	4VN	3 Apl.61
F*	8*	4VN	4 Apl.61
G	9	4T	13 Apl.61

Table I. Cod, Subarea 4, grouping of samples.
* = no otoliths.

	March		April	
Stage of Maturity	♂♂ %	♀♀ %	♂♂ %	♀♀ %
Resting	47.0	58.0	25.0	56.0
Developing	38.0	41.0	49.0	42.0
Spawning	15.0	-	26.0	-
Post-spawning	-	1.0	-	2.0
No. of obs.	203	197	111	89

Table II. Cod, Subarea 4 (R, Vn and T). Stage of maturity, determined by macroscopic observations of the gonads: March-April.

Age Group		♂♂ 1st. spawning						♀♀ 1st. spawning						
		V	VI	VII	VIII	⊖	?	Total	V	VI	VII	VIII	⊖	?	Total
VI	N	2	9	-	-	68	9	88	2	9	-	-	46	7	64
	%	2.3	10.9	-	-	77.3	10.2	100	3.1	14.1	-	-	71.9	10.9	100
VII	N	4	24	17	-	8	11	64	-	10	16	-	8	12	46
	%	6.3	37.5	26.6	-	12.5	17.2	100.1	-	21.7	34.8	-	17.4	26.1	100
VIII	N	-	6	25	-	1	2	34	-	7	14	-	-	2	23
	%	-	17.7	73.5	-	2.9	5.9	100	-	30.4	60.9	-	-	8.7	100
IX	N	-	1	9	-	-	2	12	-	2	5	1	-	-	8
	%	-	8.3	75.0	-	-	16.7	100	-	25.0	62.5	12.5	-	-	100
X	N	-	3	4	2	-	-	9	-	1	1	2	-	-	4
	%	-	33.3	44.4	22.2	-	-	99.9	-	25.0	25.0	50.0	-	-	100
XI	N	-	-	-	-	-	-	-	-	3	4	1	-	-	8
	%	-	-	-	-	-	-	-	-	37.5	50.0	12.5	-	-	100
XII	N	-	2	2	2	-	-	6	-	-	2	-	-	-	2
	%	-	33.3	33.3	33.3	-	-	99.9	-	-	100	-	-	-	100
XIII	N	-	-	1	-	-	-	1	-	-	-	-	-	-	-
	%	-	-	100	-	-	-	100	-	-	-	-	-	-	-

Table III. Cod, Subarea 4, R, Vn and T. Age at first maturity, males and females of age-groups VI-XIII; samples from March-April.

Sample-gr.	Samples	Division	Dates
A	1-3-5	3PN	24-28 Feb.61
B*	2	"	25 Feb.61
C	6-9-11	"	2-14 Mar.61
D*	8	"	4 Mar.61
E	15	"	28 Mar.61
F	16	"	1 Apl.61
G	17-20	3Ps	10-21 Apl.61
H*	19	"	19 Apl.61
I	21-22	3L	26-29 Apl.61
J*	23	"	30 Apl.61
K*	25	"	3 May 61
L	24-28-29	"	2-10 May 61
M*	27	3K	7 May 61
N	30	"	2 Jun.61
O	32-33	"	30-31 Jul.61
P*	34-37	"	1-4 Aug.61
Q	36-38-39	"	3-14 Aug.61
R	43	"	22 Oct.61
S	44-48-50-51-54	"	3-26 Nov.61
T*	47-52	"	7-23 Nov.61

Table IV. Cod, Subarea 4. Grouping of samples.
* = no otoliths.

Stage of Maturity	February ♂♂ %	February ♀♀ %	March ♂♂ %	March ♀♀ %	April ♂♂ %	April ♀♀ %	May ♂♂ %	May ♀♀ %	June ♂♂ %	June ♀♀ %	July ♂♂ %	July ♀♀ %	August ♂♂ %	August ♀♀ %	October ♂♂ %	October ♀♀ %	November ♂♂ %	November ♀♀ %
Resting	12.4	30.2	33.5	47.5	15.5	59.0	18.8	71.5	32.5	30.5	59.7	51.4	29.6	69.6	3.6	73.3	26.7	61.7
Developing.	76.4	60.4	47.5	50.5	58.0	33.8	53.6	19.1	37.5	18.6	39.5	-	58.3	-	96.4	17.8	73.3	35.2
Spawning	11.2	-	19.0	-	24.5	1.4	26.8	0.6	27.5	3.4	-	-	0.9	-	-	-	-	-
Post-spawning	-	9.4	-	2.0	2.1	5.7	0.7	8.6	2.5	47.5	0.8	48.6	11.1	30.3	-	8.9	-	3.1
No. of observ.	161	139	200	200	290	210	138	162	40	59	129	70	108	191	55	45	273	227

TABLE V. Cod, Subarea 3 (Pn, Ps, L and K). Stage of maturity, determined by macroscopic observations of the gonads: February-November.

Age Group		♂ ♂ 1st Spawning V	VI	VII	VIII	IX	⊖	?	Total	♀ ♀ 1st Spawning V	VI	VII	VIII	IX	X	⊖	?	Total
VI	N	1	28	-	-	-	247	42	318	2	30	-	-	-	-	271	30	333
	%	0.3	8.8	-	-	-	77.7	13.2	100	0.6	9.0	-	-	-	-	81.4	9.0	100
VII	N	7	38	60	-	-	22	46	173	12	25	53	-	-	-	30	44	164
	%	4.0	22.0	34.7	-	-	12.7	26.6	100	7.3	15.2	32.3	-	-	-	18.3	26.8	100
VIII	N	3	19	91	12	-	3	19	147	1	25	90	10	-	-	6	21	153
	%	2.0	12.9	61.9	8.2	-	2.0	12.9	99.9	0.7	16.3	58.8	6.5	-	-	3.9	13.7	99.9
IX	N	4	13	67	25	1	-	5	115	1	9	65	34	-	-	-	6	115
	%	3.5	11.3	58.3	21.7	0.9	-	4.4	100.1	0.9	7.8	56.5	29.6	-	-	-	5.2	100
X	N	1	11	19	25	1	-	1	58	-	5	39	22	2	-	-	2	70
	%	1.7	19.0	32.8	43.1	1.7	-	1.7	100	-	7.1	55.7	31.4	2.9	-	-	2.9	100
XI	N	2	9	23	10	1	-	1	46	1	3	28	18	4	1	-	2	56
	%	4.4	20.0	50.0	21.7	2.2	-	2.2	100.5	1.8	5.4	50.0	32.1	7.1	1.8	-	3.6	100
XII	N	-	6	18	7	1	-	1	33	2	13	29	10	4	1	-	3	61
	%	-	18.2	54.6	21.2	3.0	-	3.0	100	3.3	21.3	47.5	16.4	6.6.	1.8	-	4.1	100
XIII	N	2	3	13	4	-	-	1	23	-	2	19	7	3	-	-	-	31
	%	8.7	13.0	56.5	17.4	-	-	4.4	100	-	6.5	61.3	22.6	9.7	-	-	-	100.1
XIV	N	1	5	7	2	-	-	-	15	1	6	8	7	-	-	-	-	22
	%	6.7	33.3	46.7	13.3	-	-	-	100	4.6	27.3	36.3	31.8	-	-	-	-	100
XV	N	-	3	8	6	-	-	-	17	1	4	9	8	-	-	-	--	22
	%	-	17.7	47.1	35.3	-	-	-	100.1	4.6	18.2	40.9	36.4	-	-	-	-	100.1

Table VI. Cod, Subarea 3. Age at first maturity, males and females of age-groups VI-XV, Samples from February-November.

Ser. No. of Samples	Division	Dates
3-5-8-11	2J	15/17/21/26 May 61
23-28	2J	12-23 Sept. 61
39	2J	16 Nov. 61

Table VII. Cod, Subarea 2. Grouping of samples.