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The Danish Salmon Fishery in the Norwegian Sea in 1970

by

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1. Effort

1.1. Vessels

60 Danish vessels participated in the offshore salmon fishery in the Norwegian Sea for a longer or shorter period of 1970. A few boats (mainly the bigger ones) started the fishery during the last half of February. The majority operated from April to the end of May, while an insignificant number continued until mid June.

1.2. Gear

The fishery was exclusively carried out by means of long lines. About 1800 hooks were operated per boat. Both hooks nr. 3/0 and 6/0, with gaps between point and shank of 14 mm and 19 mm respectively were used.

A few trials were made with drift nets, but only with poor results.

The intensity of the fishery relative to the months of the season is shown in table 1 as number of hooks x shots. The figures of the table are estimated on basis of diary information from about half of the Danish total catches.

1.3. Fishing areas

Figs. 1-4, which show the geographical distribution of Danish catches per unit effort, also gives an idea of size, positions and changes of the exploited area. The catch distribution are worked out on basis of diaries of 20 vessels, i.e. one third of the Danish salmon fleet operating in the Norwegian sea.

As it appears from the charts the majority of the fishery was carried out within the limits of the latitudes  $69^{\circ}00'N$  and  $74^{\circ}00'N$  and the longitudes  $10^{\circ}00'E$  and  $20^{\circ}00'E$ . In February the fishery was concentrated in the southern part of this area. During the following month salmon fishing spread north- and eastward until lat.  $74^{\circ}00'N$  and long.  $36^{\circ}00'E$ . At the peak of the season in April the fleet concentrated in the main fishing area 50-300 naut.miles north of Lofoten Islands. Also in May long lining took place chiefly in this area. At the end of the month several boats moved southward to fishing grounds between lat.  $69^{\circ}00'N$  and  $65^{\circ}00'N$  until 100 naut.miles from the coast.

The offshore exploitation in June was negligible. Some boats were operating in the main area the first two weeks of the month. On their way home a few long line shots were made far to the south.

In general the fishery was carried out with greatest effort, where most profitable catches could be obtained, i.e. areas with a high value of catch per unit effort.

## 2. Yield.

### 2.1. Total yield

According to the fishery statistics the total yield of the Danish salmon fishery in the Norwegian sea in 1970 amounted to 415 tons, - estimated to a number of about 146,000 salmon. Mean weight 2.84 kg.

The weight stated is gutted weight of frozen salmon after reduction of 4.0 - 4.5 % for icing. Weighing of 200 salmon at sea before and after gutting and determination of frozen weight with and without ice covering showed an average loss in weight from round to landed, gutted and thawed salmon of 13.7 %. To obtain round weight of the total yield, the statistical data on weight has to be increased with 15.9 %.

An unknown number of salmon entering the catches was discharged, being too small and too lean. Observations on long line hauling showed that 5 % of a catch of 450 salmon was released into the sea for the reasons mentioned.

### 2.2. Market categories.

In table 2 the total yield is distributed on market categories as well by number as by weight.

As an overall average the size of salmon that entered the catches did not show any great variations from month to month. In the main area lat.  $69^{\circ}00'N$  -  $74^{\circ}00'N$ , long.  $8^{\circ}00'E$  -  $22^{\circ}00'E$  mean weight (gutted) per salmon remained between 2.7 kg and 2.8 kg during February - May, but rose to 3.3 kg in June.

East of lat.  $22^{\circ}00'E$  the average size of salmon was significantly larger during the whole season. One boat for example long lining between long.  $26^{\circ}00'E$  and  $36^{\circ}00'E$ , south of lat.  $74^{\circ}00'N$  from mid March until second week of May recorded a yield, of which 34.0 % of the individuals belonged to the market categories 5 - 9 kg, while 22.6 % were still bigger. In return the number of salmon caught per 1000 hook averaged only 22.8, i.e. one third of the number caught per unit effort in the main fishing area at that time.

Salmon from the area south of lat.  $68^{\circ}00'N$  exploited in May and June were also relatively large. The average weight amounted to 4.5 kg.

Differences in the catches with respect to mean weight per salmon above all reflect differences in age composition of the stocks exploited.

### 2.3. Catch per unit effort

Catch per unit effort varied significantly with time and fishing area. Table 1 shows the monthly average yield per unit of gear estimated from catches of 72,000 salmon.

According to available information on drift net trials in May an average of 4.0 salmon were retained per 100 nets. Experiments with nets in the beginning of the season gave still inferior results.

Distribution of catch per unit effort by areas and months based on diary information is demonstrated in figs. 1 - 4. Four hatchings are used, representing catches of less than 25 salmon, 25 - 50 salmon, 50 - 75 salmon and more than 75 salmon per 1000 hooks respectively.

### 3. Catch Composition

Investigations on the composition of the salmon catches from the Norwegian Sea as to size, age, condition and sex were carried out by means of market examinations and sampling at sea from a commercial vessel. A total of 3,814 salmon distributed on eight samples from different periods of the season were measured and weighed. As nearly all the salmon entering the Danish fishery in the Norwegian sea are landed in frozen and iced condition, scale samples can only in a few exceptional cases be collected on the fishmarket. However from a single landing of cooled salmon and from the sampling at sea, scales of 523 salmon were collected by stratified sampling.

The frozen salmon were measured to fork length and weighed with the ice covering. Fork length is converted to total length by adding 1 cm to each 1 cm-group. According to the investigation on loss of weight from catch to landing previously mentioned, weights of frozen salmon are in relation to their size converted to round weight by the range of factors 1.096 - 1.122. The weight of cooled salmon is likewise converted to round weight, but with the factors 1.136 - 1.172. The cooled salmon as well as the salmon examined at sea were measured to total length.

#### 3.1. Length distribution.

Table 3 and figs. 5a, 5b and 5c show the length-frequency distribution of salmon caught in different periods of the season. With respect to time and fishing area the eight samples are grouped as follows:

- a. Mid February - mid March: 60 - 150 naut. miles W - N of Andenes.
- b. Mid April - end of April: 60 - 200 naut. miles W - NW of Andenes.
- c. Mid May - mid June: 40 - 150 naut. miles NW of Andenes.

(Andenes: 69°20'N, 16°10'E)

During the period covered by the samples, the average growth judged from the mode of the length-frequencies amounted to about 7 cm.

### 3.2. Age distribution

Based on analysis of scale samples collected from catches made during the last half of April and the last half of May and on the assumption that average growth of salmon from February to June amounted to about 7 cm, an estimation have been made on the age composition of the three groups of catches mentioned in 3.1 (table 4).

### 3.3. Sex ratio

In table 5 is shown the result of an examination of the sex composition of 424 salmon, i.e. the total catch made by a commercial vessel 22 - 31 May 1970. The examination was carried out in connection with scale sampling, therefore the sex ratio is shown both in relation to length and age.

### 3.4. Length weight relationship

The length weight relationship of salmon exploited in the Norwegian Sea varies both with respect to size of individuals and to time of the season (fig. 6). The diagram shows the correlation between length and condition factor of salmon belonging to the three groups of catches examined. The condition factor ( $K = \frac{W}{l^3}$ ) is calculated as a mean of 5 cm length groups (w: round weight, l: total length).

An attempt has been made to estimate average condition factors of each of the three sea age groups of salmon, that enters the high seas fishery (table 6). Owing to lack of age determination of every single individual of the 3,814 salmon included in the length-weight measurements, the average condition factors of the age groups have been estimated on basis of a simple division of the catches according to their age composition (see table 4).

Salmon taken by the offshore fishery in the Norwegian Sea show a remarkably wide range of condition at any rate in spring. The weight of specimens of a given length may vary more than 100%. In figs. 7a, 7b and 7c is shown the percentage frequency distribution of condition

factors of individuals belonging to the length groups 64 - 74 cm, 68 - 78 cm and 70 - 80 cm selected from the previously mentioned three groups of catches respectively.

The results obtained by analysis of the length weight relationship may possibly be explained when considered in the light of the spawning recruitment from the offshore stock of salmon to the coastal areas.

According to table 6 and fig. 6, the condition factor of the sea age group A.1 seems to increase during spring, while the older specimens are on their hight in February and early March. The decreasing or stagnating mean condition of the A.2- and A.3-population might be interpreted as a consequence of gradual migration from the feeding grounds in the Norwegian Sea of individuals having obtained sufficient fat accumulation for spawning. The remaining population of more or less meager individuals of these age groups will not acquire spawning condition until later in the summer or next year.

The reason why the average condition factor of A.1-salmon does not show the same tendency, but on the contrary rises during spring, may be that grilse in relation to the older spawners run later and constitute a relatively smaller proportion of the age group to which they belong. Therefore the mean condition of pregrilse in the sea is apparently not affected by migration during the long lining period.

The shape of the condition factor-frequency distribution (figs. 7a, 7b and 7c) supports the theory above. The skewness to the right of the histograms especially b and c for the last two periods of the season suggests removal from the offshore population of individuals with high mean condition factor as a consequence of spawning migration.

Table 1. Monthly distribution of effort, catch and catch per unit effort of the Danish salmon fishery in the Norwegian sea 1970.

Months	Number of hooks x shots		Number of salmon caught		Number of salmon per 1000 hooks
		%		%	
February	100,000	3.3	4,200	2.9	42.0
March	679,000	22.7	33,900	23.2	49.9
April	1,018,000	34.0	68,000	46.4	66.8
May	988,000	33.0	34,500	23.6	34.9
June	208,000	6.9	5,700	3.9	27.4
<b>Total</b>	<b>2,993,000</b>		<b>146,300</b>		<b>48.9</b>

Table 2. Distribution on market categories of the Danish salmon catches in the Norwegian Sea 1970.

Market categories	Number	Weight	
		kg	%
I 9 kg -	1,600	16,800	4.1
II 7 - 9 kg	2,500	19,600	4.7
III 5 - 7 "	6,400	36,600	8.8
IV 4 - 5 "	9,700	40,700	9.8
V 3 - 4 "	24,300	82,900	20.0
VI 1 - 3 "	95,800	204,700	49.3
sec.+)	6,000	13,600	3.3
<b>Total</b>	<b>146,300</b>	<b>414,900 kg</b>	

+) This category contains extraordinary lean salmon, but mainly small specimens of less than 3 kg.

Table 3. Length-frequency distribution in per cent of 3,814 salmon caught in the Norwegian Sea in different periods of the season 1970.

5 cm length groups (total length)	Mid February- mid March	Mid April- end of April	Mid May- mid June
120 - 125 cm	0.1	-	-
115 - 120 "	-	0.1	-
110 - 115 "	-	0.1	0.1
105 - 110 "	-	0.1	-
100 - 105 "	0.3	1.0	0.6
95 - 100 "	0.5	1.3	1.1
90 - 95 "	0.7	2.3	2.1
85 - 90 "	3.0	7.1	7.4
80 - 85 "	9.0	12.2	15.9
75 - 80 "	15.3	23.0	22.9
70 - 75 "	26.7	26.6	17.8
65 - 70 "	25.3	17.6	11.8
60 - 65 "	11.0	5.3	7.5
55 - 60 "	1.8	1.9	6.0
50 - 55 "	3.6	1.2	5.4
45 - 50 "	2.4	0.2	1.3
40 - 45 "	0.1	-	-
Number of salmon examined:	952	2,064	798

Table 4. Sea age composition in per cent of 3,814 salmon caught in the Norwegian Sea in different periods of the season 1970.

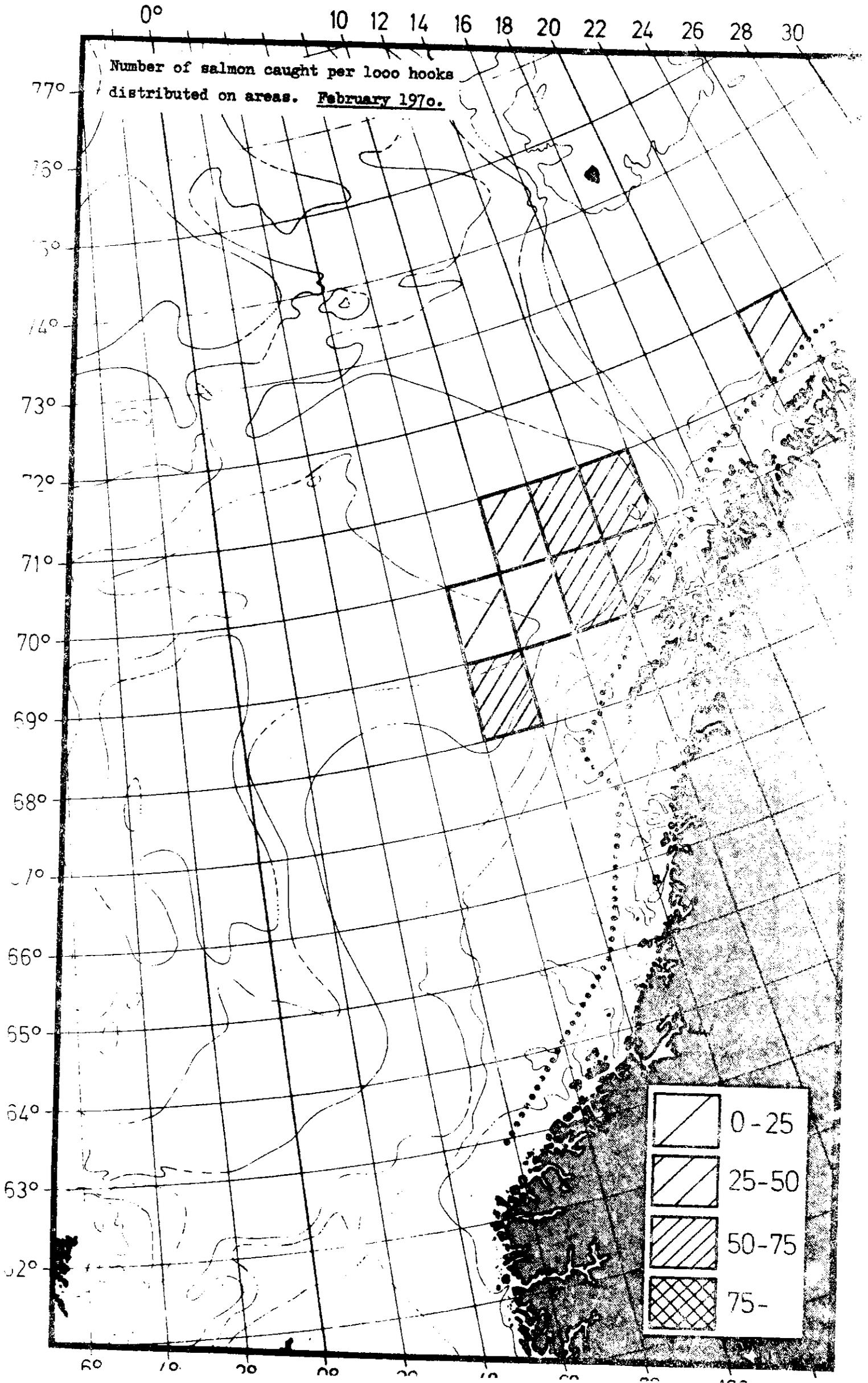
Sea age	Mid February- mid March	Mid April- end of April	Mid May- mid June
A.3 (and older)	0.7	3.1	2.7
A.2	91.7	93.0	80.2
A.1	6.6	3.9	17.1

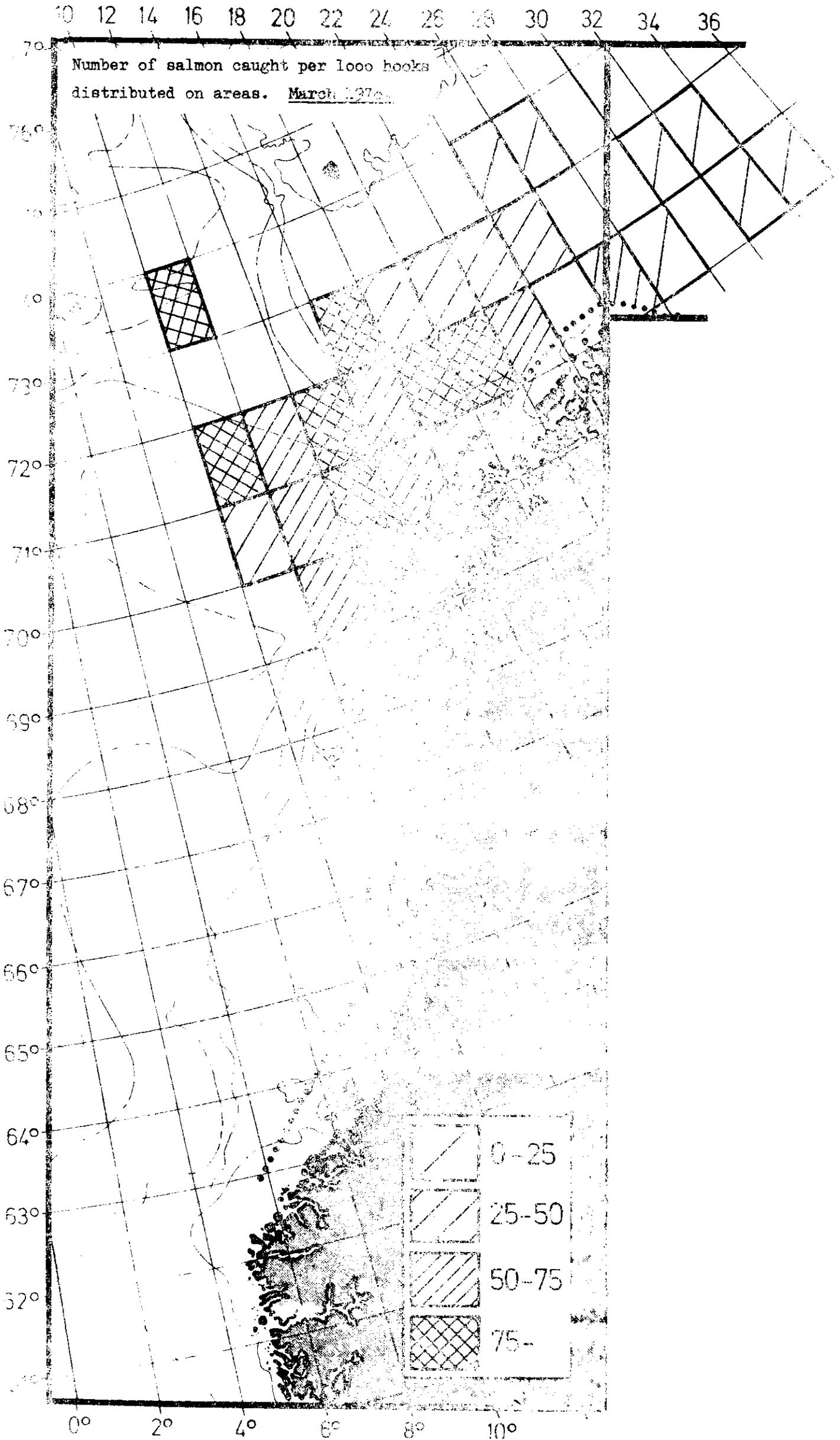
Table 5. Sex ratio in relation to length and age of 424 salmon caught in the Norwegian Sea 22 - 31 May 1970.

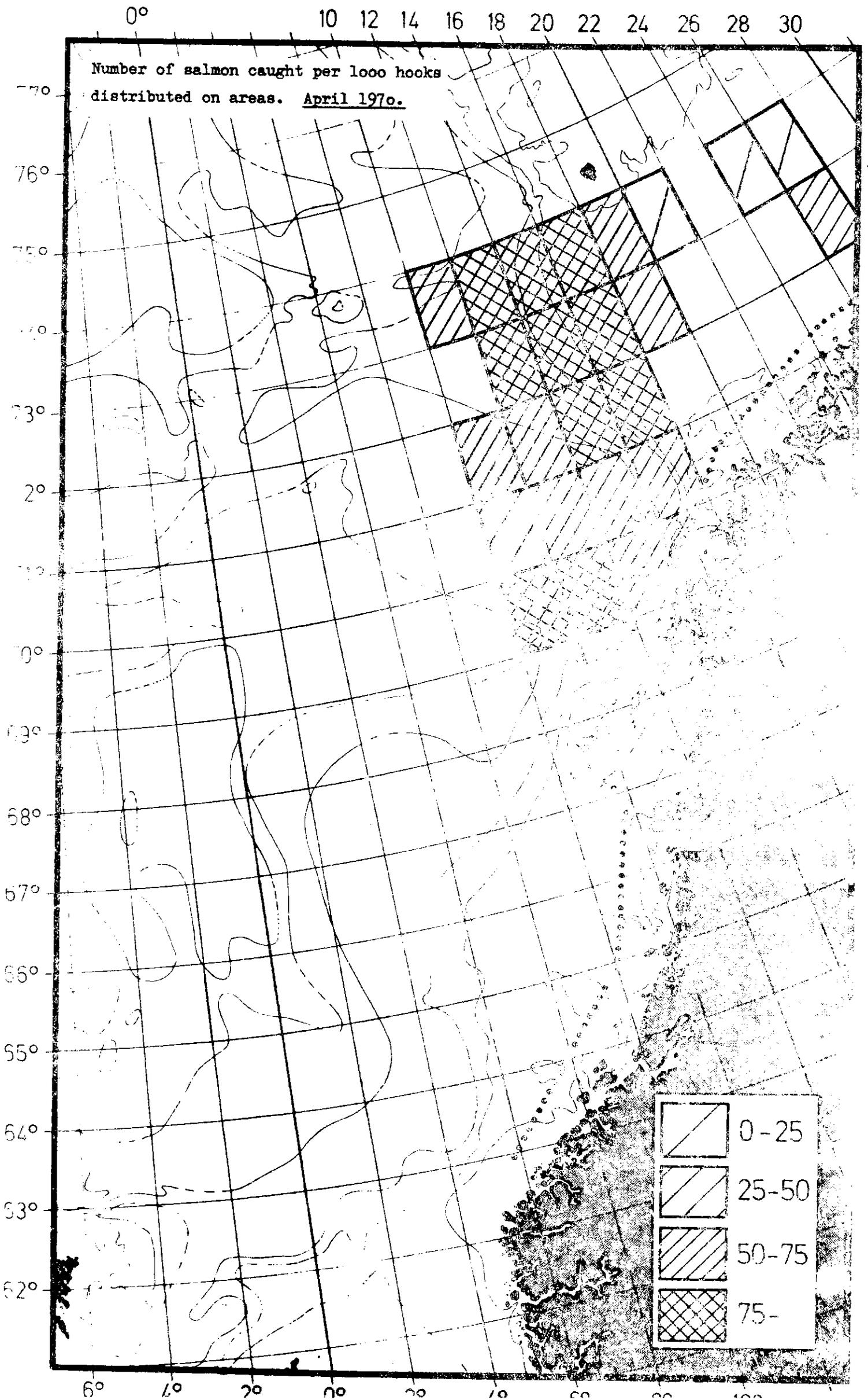
5 cm length groups (total length)	♂♂			♀♀		
	A.1	A.2	A.3	A.1	A.2	A.3
110 - 115 cm	-	-	1	-	-	-
105 - 110 "	-	-	-	-	-	-
100 - 105 "	-	-	3	-	-	-
95 - 100 "	-	-	-	-	-	3
90 - 95 "	-	2	-	-	1	1
85 - 90 "	-	6	-	-	10 + 1PS	-
80 - 85 "	-	19	-	-	38	-
75 - 80 "	-	26	-	-	66	-
70 - 75 "	-	12	-	-	61	-
65 - 70 "	3	3	-	2	41	-
60 - 65 "	11	6	-	8	16	-
55 - 60 "	23	-	-	11	1	-
50 - 55 "	24	-	-	15	-	-
45 - 50 "	4	-	-	6	-	-
Total number	65	74	4	42	235	4
Total %	15.3	17.5	0.9	9.9	55.4	0.9

Table 6. Average condition factors of the sea age groups of salmon caught in the Norwegian Sea in different periods of the season 1970.

Sea age	Mid February- mid March a	Mid April end of April b	Mid May- mid June c
A.3 (and older)	0.93	0.93	0.88
A.2	0.77	0.74	0.75
A.1	0.73	0.76	0.80



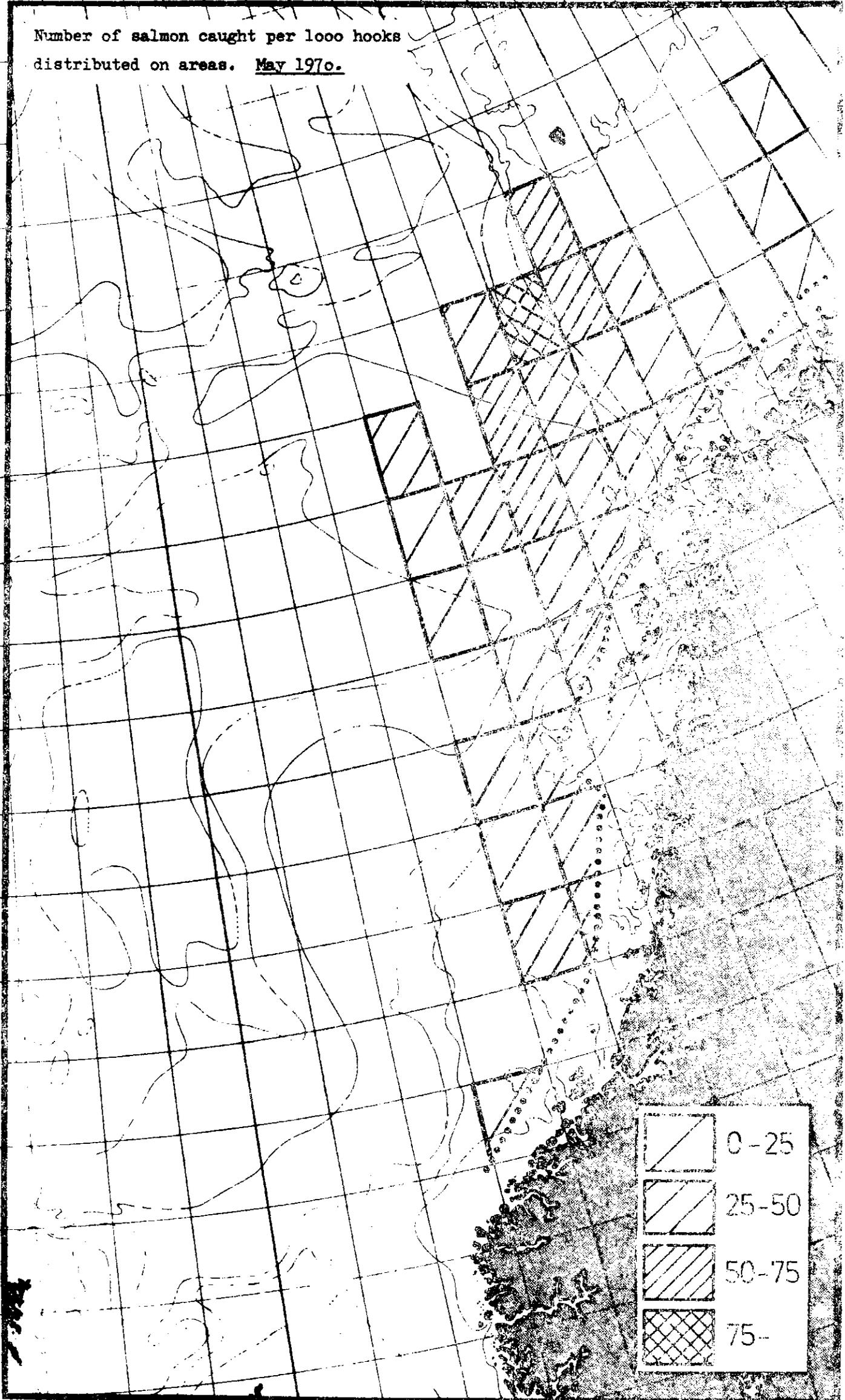




0° 10 12 14 16 18 20 22 24 26 28 30

Number of salmon caught per 1000 hooks distributed on areas. May 1970.

75°  
74°  
73°  
72°  
71°  
70°  
69°  
68°  
67°  
66°  
65°  
64°  
63°  
62°



6° 4° 2° 0° 2° 4° 6° 8° 10°

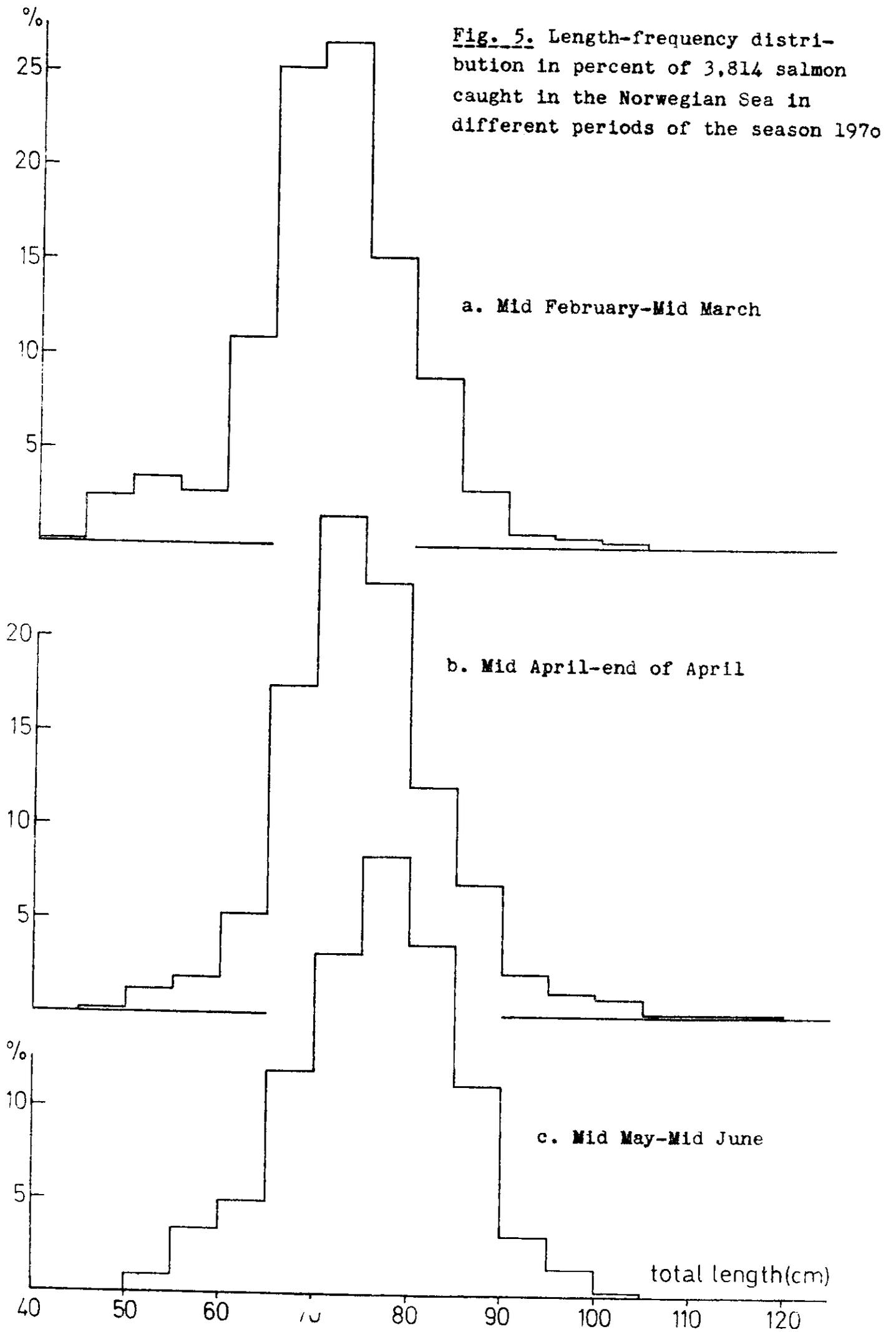


Fig. 6. Relation between length and condition factor of 3,814 salmon caught in the Norwegian Sea in different periods of the season 1970. (K calculated as an average of 5 cm length groups. Average values based on less than 5 salmon are not plotted).

$$K = \frac{W}{L^3} \begin{matrix} \text{(round weight)} \\ \text{(total length)} \end{matrix}$$

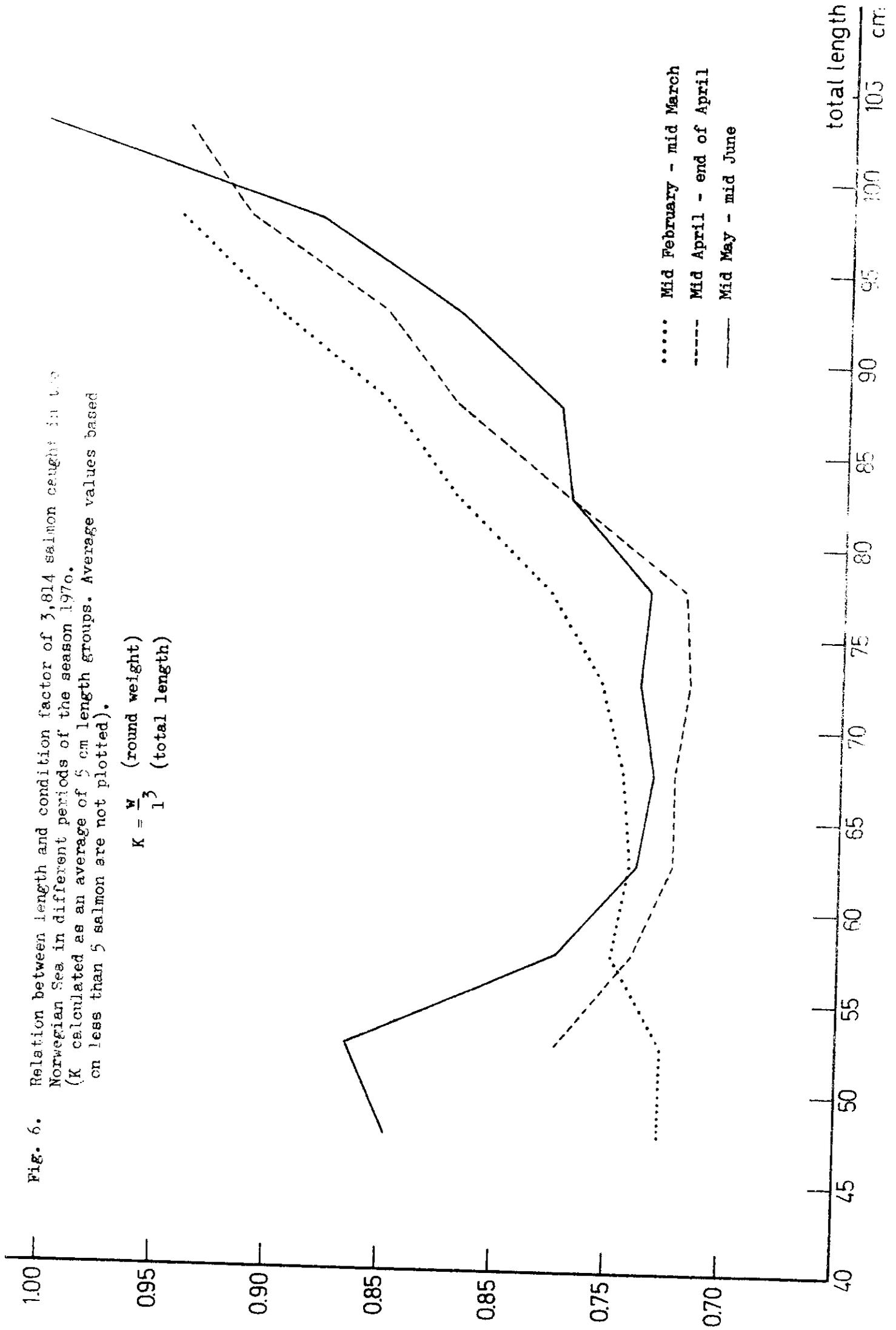


Fig. 7. Frequency distribution of condition factors calculated from 10 cm length groups of salmon caught in the Norwegian Sea in different periods of the season 1970.

$$K = \frac{W}{l^3} \begin{matrix} \text{(guttet, frozen weight)} \\ \text{(total length)} \end{matrix}$$

