



Serial No. 2535
(B.g.14)

ICES/ICNAF Salmon Doc. 71/9
(also ICNAF Res.Doc. 71/65)

ANNUAL MEETING - JUNE 1971

Observations on Selectivity and Relative Efficiency of Salmon
Drift Nets in Connection with Population Studies on Salmon at
West Greenland.

by

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With the object of estimating the age and size distribution of the salmon stock in Greenland waters investigations on the selectivity of drift nets were carried out in the autumn 1970 on some West Greenland fishing grounds.

The offshore salmon fishery at West Greenland is predominantly a drift net fishery. Salmon long lines are operated too, but only on a small scale. Before 1969 Danish salmon vessels were exclusively equipped with multifilament nets manufactured from twine of twisted synthetic fibres (Polyester). Besides using multifilament nets two of the Danish vessels participating in the Greenland fishery in 1969 also experimented with monofilament nylon nets (Polyamid). In the salmon fishing season 1970 all the vessels except one were equipped with monofilament nets, either exclusively as far as two boats concerned or as a supplement to the conventional multifilament nets.

The multifilament nets operated in Greenland waters are usually of the type which was introduced in the Baltic salmon drift net fishery during first half of the sixties. Dimensions: generally 27 m long and 5 - 6 m deep. Mesh size: 160 mm (stretched mesh). Mounting: generally the proper net is mounted with strops to the floating line. The net is hauled along the floating line by hand. A somewhat modified type was fished from the vessel "Polarlaks" in 1969, as shall be referred to later on. Strops were inserted not in connection with the floating rope, but between the proper net and the foot rope which was lightly weighted.

Monofilament nets for salmon fishing are of various manufactures and qualities as well with respect to colour, thickness, elasticity of the twine as to kind of knots. Dimensions: generally 34 m long and 5 - 6 m deep. Mesh size: 130 - 160 mm. Mounting: the proper net is fixed directly to the floating rope and connected to the foot rope with strops. The gear is hauled along the foot rope by a special winch.

The present population study is based upon observations on the selectivity of drift nets made on board the Danish commercial fishing vessel "Polarlaks" during salmon fishing off the coast of West Greenland in the autumn 1970. The report also includes some observations on drift netting from the same vessel the year before. Available data on salmon catches of other vessels have likewise been used.

When the investigation started in August 1970 "Polarlaks" was operating 609 monofilament nets distributed as follows:

<u>Mesh size</u>	<u>Numbers</u>
130 mm	265
140 "	135
150 "	97
160 "	101

Besides, 25 nets with 170 mm meshes were used experimentally during a part of the period of investigation. The nets were shot in chains at about 100, and within each chain nets with small and large meshes were tied up alternately.

During two periods September 1st - 7th and 10th - 17th while fishing in the areas about $69^{\circ}45'N$, $55^{\circ}15'W$ and about $61^{\circ}15'N$, $49^{\circ}00'W$ respectively observations were made on catches by nets of the different mesh sizes. The netted salmon were measured (fork length) and the mesh size of the corresponding nets was determined by a mesh gauge. Effort data were obtained by recording the number of nets of the various mesh sizes used and the fishing time of each chain of nets. However, as no correlation was observed between number of salmon retained and the time of fishing, the estimated catch-per-unit-effort values are only expressed as number of salmon retained per net unit.

Table 1 summarizes the observations made during fishing in the two areas concerned. The estimations are based upon measurements of 1901 salmon. Catch-per-unit-effort data recorded from the fishing area $69^{\circ}45'N$, $55^{\circ}15'W$ have been used in the calculations of selectivity for both areas, as corresponding data from the fishing area $61^{\circ}15'N$, $49^{\circ}00'W$ are too scarce and therefore not sufficiently reliable. The results are represented graphically in fig. 1. As the catches in nets of 170 mm were extremely poor, they are excluded from the diagrams. The same was the case with respect to nets of 160 mm in the southernmost area.

For the sake of comparing the relative efficiency of nets fished from "Polarlaks" with nets of corresponding mesh sizes operated from other vessels, all available information on catch per unit effort of a range of mesh sizes is shown in table 2. The data are listed according to vessels, date and fishing area.

An attempt has been made to estimate the length-frequency of the salmon population in Greenland waters. For this purpose a formal model of gill net mesh selection has been used which implies the following assumptions: 1) Mean and standard deviation of the length-frequency distribution of the salmon retained is proportional to mesh size. 2) Fishing power of nets is independent of mesh size. The application of the model to the material did not, however, lead to results on which an estimation of a probable length-frequency distri-

bution of the salmon population could be based. The reason may be either that the assumptions made are not valid or that the observations were too few.

Considering the remarkable decline in catch efficiency from the smallest to the largest meshes it cannot be rejected that on account of certain properties attached to the nets the fishing power of the various nets may depend on mesh size. One such property may be the elasticity of the monofilament twine. According to tests on tension and breaking strength the twine of the nets in question can be stretched about 20 % before parting. Consequently the effective mesh size within certain limits is depending on the strain applied. Supposing that the strength of a salmon is proportional to the size of the individual, it might be expected that the number of escaping big salmon entering large meshes will be relatively greater, than the corresponding loss of small salmon in nets of small meshes.

As the study of net selection failed to give any results, the observations only provide rather uncertain information on the age and size composition of the stock of salmon in West Greenland waters. Some conclusions are however drawn as shall be mentioned in the following.

In spite of the significantly different selectivity of the nets operated, average length of salmon retained by nets of different mesh sizes varies relatively little as shown by following means:

Mesh size:	130 mm	140 mm	150 mm	160 mm
69°45'N, 55°15'W	64.8 cm	66.1 cm	68.1 cm	72.2 cm
61°15'N, 49°00'W	63.7 "	65.1 "	67.2 "	-

Unless the properties attached to monofilament nets as mentioned above reduce their fishing power quite extraordinary with increasing mesh size, the figures seems to indicate a relatively small proportion of A.2+ salmon in the population at West Greenland.

Length distribution of the catches made in the two areas where the majority of the fishery took place during first half of September, revealed a certain variation of stock composition at West Greenland, as it appears from table 1 and fig. 1. The proportion of salmon of 75 cm and above - roughly speaking age group A.2+ - in nets of different mesh size was as follows:

Mesh size:	130 mm	140 mm	150 mm
69°45'N, 55°15'W	3.0 %	4.3 %	10.8 %
61°15'N, 49°00'W	1.0 %	1.3 %	2.2 %

Differences in condition of salmon taken in the two areas could also be demonstrated. Based on length and weight measurements of a representative sample of 49 and 99 salmon caught at 69°45'N, 55°15'W and 61°15'N, 49°00'W,

the condition factor of the two populations was estimated to 1.02 and 1.07 respectively (fork length and round weight). The difference is statistically significant ($0.05 > P > 0.025$).

As the ability of gill nets to retain fish of a given size depends on the condition of the fish, differences in length composition of corresponding age groups of salmon caught in the two areas might be expected. Such differences could not be found, as it appears from fig. 1.

In default of estimates of stock composition and gear selectivity relative exploitation rates of the individual length and age groups cannot be evaluated. It may however be pointed out that the highest yield of a length group per unit of gear was obtained of individuals between 60 cm and 65 cm by nets with the smallest mesh size used, i.e. 130 mm. The mean length of the population of A.1-salmon therefore is supposed to be less than 65 cm at the time of investigation, which suggests that the smaller individuals of this age group are exploited less than the bigger individuals even by nets of 130 mm meshes. It cannot be excluded, that nets with still smaller meshes might have taken even more salmon per net unit.

Differences with respect to selectivity and catching efficiency of multifilament nets of 160 mm meshes in relation to monofilament nets of various mesh sizes are shown in table 3 and 4. Unfortunately the material do not allow an exact separation of the catches by monofilament nets with respect to mesh size. Referring to table 4 monofilament nets are put together in two groups, 130 mm + 140 mm nets and 150 mm + 160 mm nets. In the former group the two mesh sizes are represented by 65 % and 25 % respectively, while the remaining 10 % consists of nets of 150 mm and 160 mm. The latter group of nets is exclusively represented by 150 mm and 160 mm nets in the ratio 2:1. On account of differences in length of the two net types in question, values of catch per 100 multifilament nets are converted in order to make them comparable to catches of monofilament nets.

It appears from the tables that multifilament nets of 160 mm are superior to monofilament nets of roughly speaking the same mesh size in catching salmon, but are outnumbered by monofilament nets of 130 mm and 140 mm.

A comparison between the length distribution of catches by 160 mm multifilament and 130 + 140 mm monofilament nets (fig. 3) discloses an amazing uniformity in spite of the difference of mesh size. This probably implies that nets of same mesh size but manufactured by different sorts of twine, monofilament and multifilament, are not only different as to catching efficiency but also with respect to selectivity. Apparently the two kinds of net do not possess a uniform catching ability; this may be explained in different ways, a.o. (1) Multifilament nets are no doubt more visible in the sea than monofilament nets. (2) Multifilament nets - either entirely lacking or only with a light foot rope - are not so hard vertically stretched as the heavily weighted monofilament nets. The latter are gill nets in the proper sense of the word, whereas multifilament nets are retaining salmon more by entangling.

Table 1. Number of salmon in 5 cm-length groups retained per 100 monofilament nets in relation to mesh size. Data from commercial catches at 69°45'N, 55°15'W, September 1st - 7th and at 61°15'N, 49°00'W, September 10th - 17th 1970.

5 cm-length groups (fork length)	69°45'N, 55°15'W					61°15'N, 49°00'W		
	Mesh size (mm)					Mesh size (mm)		
	130	140	150	160	170	130	140	150
95 - 100 cm	0.1	-	-	-	-	-	-	-
90 - 95 "	-	-	-	-	-	-	-	-
85 - 90 "	0.1	0.3	0.4	0.6	-	0.1	-	-
80 - 85 "	0.4	1.4	1.1	2.5	-	0.2	0.5	0.5
75 - 80 "	1.3	-	0.9	1.5	1.3	0.2	-	-
70 - 75 "	4.3	2.4	2.8	3.4	-	2.4	2.5	4.8
65 - 70 "	19.7	18.6	9.6	4.5	1.3	20.4	18.2	11.5
60 - 65 "	24.4	14.9	5.8	2.1	2.5	26.6	14.9	4.3
55 - 60 "	10.2	3.6	1.3	0.7	-	10.1	5.4	0.9
50 - 55 "	1.2	0.3	0.2	-	-	1.6	-	-
45 - 50 "	0.1	-	-	-	-	-	-	-
Total number of salmon per 100 nets:	61.7	41.5	22.0	15.3	5.1	61.7	41.5	22.0
Number of salmon	765	257	103	81	4	492	153	46

Table 2. Number of salmon retained per 100 monofilament nets in relation to mesh size. Information from 4 commercial vessels at West Greenland. August - October 1970.

Vessel no.	Date	ICNAF stat. area	Number of salmon per 100 nets				Basis of calculations (number of nets)
			Mesh size (mm)				
			130	140	150	160	
II	30 - 31 Aug.	1B	76.0	57.8	18.8	-	1000
I	1 - 7 Sept.	1A	61.7	41.5	22.0	15.3	2720
III	6 "	1B	74.0	-	32.0	18.0	300
III	5 - 7 "	1B	64.0	-	29.0	-	600
II	1 - 7 "	1A	94.6	72.7	24.3	-	3100
II	11 - 21 "	1E	96.3	86.3	-	-	1300
IV	17 Sept. - 6 Oct.	1E	-	45.6	23.4	-	5820

Table 3. Number of salmon in 5 cm lengthgroups retained per 100 nets in relation to type of twine and mesh size of nets. Data from commercial fishing within the area 67°00'N - 67°37'N and 54°15'W - 55°00'W, October 18th - November 2nd 1969.

5 cm-lengthgroups (fork length)	Multifilament nets	Monofilament nets
	160 mm	130 mm + 140 mm
95 - 100 cm	-	0.05
90 - 95 "	0.2	0.1
85 - 90 "	0.3	0.5
80 - 85 "	1.4	1.8
75 - 80 "	2.3	4.1
70 - 75 "	11.8	15.8
65 - 70 "	11.8	16.8
60 - 65 "	4.3	6.0
55 - 60 "	0.5	1.0
50 - 55 "	-	0.05
Total number of salmon per 100 nets:	32.7	46.3
Number of salmon measured:	210	1131

Table 4. Number of salmon retained pr. 100 nets in relation to type of twine of the nets. Information from 2 commercial vessels at West Greenland. October - November 1969 and August - November 1970.

Vessel no.	Date	ICNAF stat. area	Multi- filament nets 160 mm	Monofilament nets		Basis of calculations (number of nets)
				130 + 140 mm	150 + 160 mm	
I	<u>1969</u>					
	18 Oct. - 2 Nov.	1B	32.7	46.3	-	6260
II	<u>1970</u>					
	10 - 31 Aug.	1B	27.8	-	18.3	4000
	1 - 15 Sept.	1A	25.1	-	13.4	3680
	25 "	1D	6.0	-	3.5	700
	26 Sept. - 13 Nov.	1B	24.6	-	14.8	7050

Fig. 1. Number of salmon in 5 cm-length groups retained per 100 nets during fishing in the areas about 69°45'N, 55°15'W and about 61°15'N, 49°00'W, September 1st - 17th 1970.

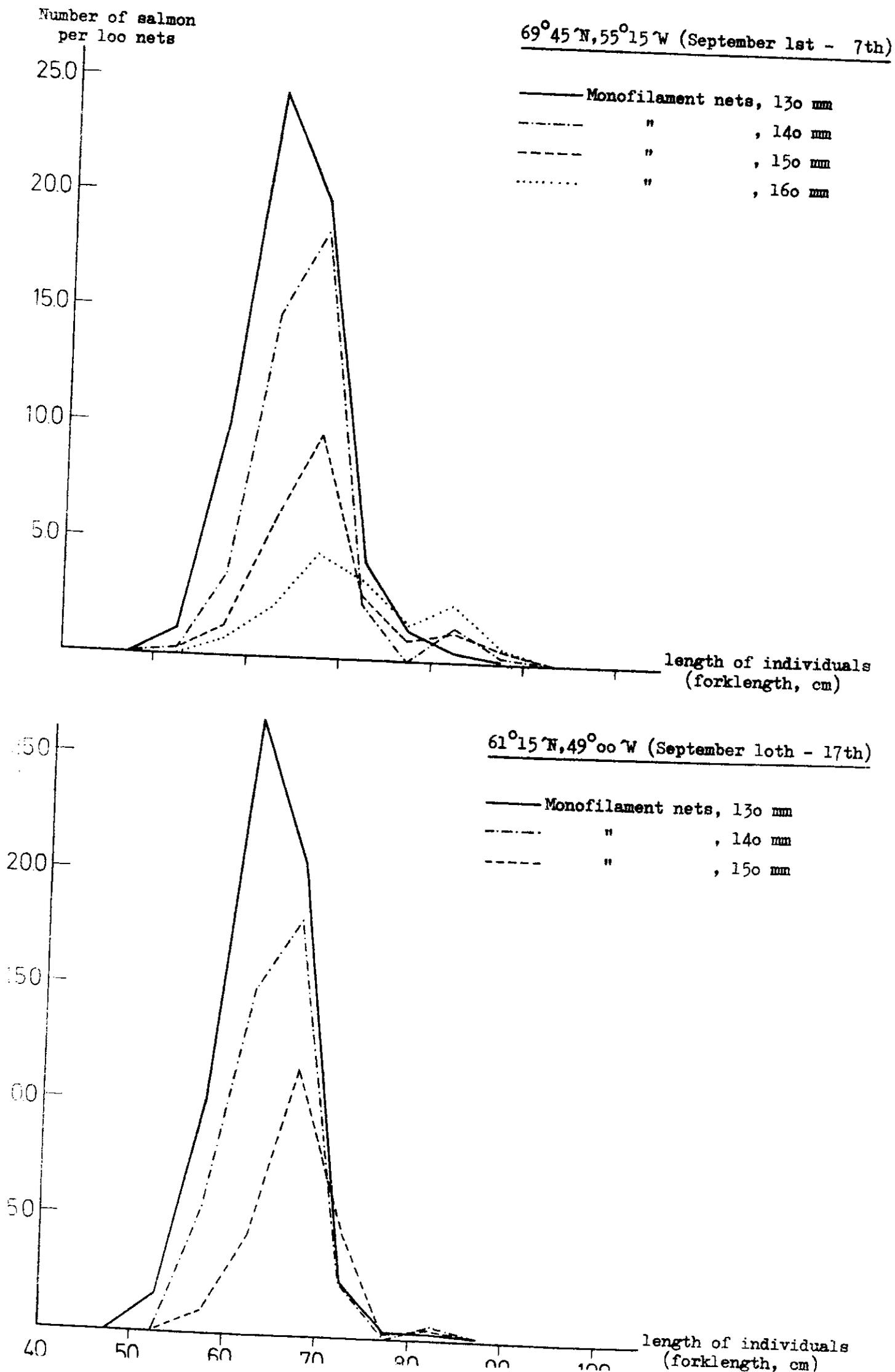


Fig. 2. Number of salmon in 5 cm-lengthgroups retained per 100 nets during fishing within the area $67^{\circ}00'N - 67^{\circ}37'N$ and $54^{\circ}15'W - 55^{\circ}00'W$, October 18th - November 2nd 1969.

