RESTRICTED

International Commission for the Northwest Atlantic Fisheries

Serial No. 3229
(B.g. 14)

ICNAF Res.Doc. 74/43

ANNUAL MEETING - JUNE 1974

Distribution and abundance of salmon at West Greenland[1]

by

O. Christensen
Danmarks Fiskeri-og Havundersøgelser
Charlottenlund Slot
Denmark

and

W.H. Lear
Fisheries and Marine Service
Environment Canada
Biological Station
St. John's, Newfoundland, Canada

Introduction

Exploitation of salmon in Greenland waters first developed to any extent in the early sixties. Originally only set gill-nets were operated inside fjords and islands by local fishermen. In 1965 Faroese and Norwegians succeeded in offshore salmon fishery with drift-nets, soon to be followed by Danes and Greenlanders. The only statistical data on the fishery from the very start are annual catches in metric tons by nations (Table 1). Even though the table provides only the annual catches, it does indicate an extremely rapid development of fishing intensity, which can be confirmed by a survey of the participating drifters not registered in Greenland (Table 2). The limitations of the fleet since 1970, however, does not reflect a corresponding decrease of fishing power. Although insufficient data for an accurate estimate are available, it is assumed that average fishing capacity at least has doubled in the years 1968-71.

The inshore set gill-net fishery is carried out along the west coast of Greenland from Julianehåb to Disko, lat. 60°00'N-70°00'N with main centers of fishing in the vicinity of the large towns. Some limited catches are taken as far north as Upernavik, lat. 72°45'N and at Angmagssalik on the east coast.

Numerical information on the set gill-net fishery is limited to annual catches distributed by districts, viz. the ICNAF Division 1A-1F (Table 3). These data are not available by seasons prior to 1963; and after 1968, when drift-netting was adopted by the Greenlanders, the catches of the two fishe-

[1] Presented to the ICES/ICNAF Joint Working Party on North Atlantic Salmon, ICES, Charlottenlund, March 1974.

ries cannot be separated. The additional drift-netting does not seem to change the distribution of catches on districts, however. In some years the majority of the catches is landed in the districts north of Godthåb, in other years salmon seem to be more abundant and/or available to the south. Much information on quantitative occurrence of salmon in coastal waters is not supplied by the table, as no data on effort can be produced.

Prior to 1969 the drift-net fishery was mainly confined to the area of the Store Hellefisk Bank, extending as far south as Kangamiut in the early part of the season. In 1969 the fishery spread over a rather wider area, extending from Sukkertoppen in the south to Disko in the north, and in the following years extending all along the west coast from Disko area to Julianehåb. From the commercial drift-net fishery, diary information on fishing positions in number of gear operated and corresponding yields are compiled since 1970, which enable a general impression of the distribution and relative abundance and/or availability of salmon in West Greenland offshore waters. Tables 4, 5, 6 and 7 show per bi-weekly period, and fishing areas, the effort, catch and catch per unit effort of a more or less considerable part of the drift-net fleet in the seasons 1970, 1971, 1972 and 1973. In the 1970 table the data are grouped according to ICNAF Divisions, whereas areas selected with special reference to an appropriate distribution of the salmon fishery are applied for the subsequent three seasons (Fig. 1).

A glance at the four tables reveals very few common trends as to seasonal occurrence of salmon over time and place, described by the catch-per-unit-effort figures. Salmon seem to be abundant offshore from July to November-December to the extent they can be captured in set gill-nets on the coast. There is a tendency for the fishery to start later in the Disko area than in the other areas. When in some years the season starts later in the southernmost areas the reason may be ice difficulties. The values of the overall fishing per period at the bottom of the tables suggest a general decline of occurrence from August and throughout the season, but considering especially the year 1970 this tendency is not quite consistent.

Gear and Methods

With the aim of determining to what degree the catches of salmon are effected by food, wave hight, wind force and direction during fishing, each of these factors was investigated in connection with the execution of the international salmon tagging experiment at West Greenland in 1972. The changes in the catch per unit effort as a result of these influences may or may not be a direct reflection of the changes in relative abundance of salmon, but may merely suggest a change in behaviour, e.g. vertical migration which makes them less vulnerable to the fishing gear. In the following the gear operated and the data collected by the vessels involved in the tagging experiment shall be described. Likewise a discussion on the most appropriate indices of effort is included in this section.

Gear.

In the tagging experiment 4 research vessels and 8 out of the total fleet of 22 commercial vessels not registered in Greenland participated.

The majority (more than 9o %) of the drift-nets operated by the commercial vessels were manufactered from monofilament nylon twine o.5 - o.6 mm, with a mesh size of 13o or 14o mm. The reminder were multifilament nylon nets. The length of the nets varied from 18 m to 37 m, but by far the greater part were about 33 m, extending to a dept of about 5 m. The top of the nets were mounted with floats or a floating rope. A combined sinking and hauling rope was mounted with strops to the footrope. The individual nets were tied together in units of usually 1oo. In most of the fishing operations the nets are shot about sunset. Hauling starts before sunrise and is finished earlier or later in the day depending on weather, number of nets entangled, number of seabirds as bycatches etc.. Certain conditions, such as weather, ice and proximity to the shore necessitated fishing at daylight, generally with a limited amount of gear.

The nets operated by the research vessels were monofilament nylon nets exclusively, 46 m long, 3-4 m deep, half of them with a mesh size of 13o mm and the other half 15o mm. The basic gear units consisted of 2o nets arranged with 1o nets with 13o mm meshes followed by 1o nets with 15o mm meshes. While the nets of the "Adolf Jensen" were mounted similar to the commercial nets, the nets of the other 3 research vessels were equipped with a strengthning rope, used for hauling, attached to the headrope.

Material.

The following data relevant to the present study were collected by the staff of the research vessels and by observers placed on board the commercial vessels involved: approximate mid point position and approximate duration of fishing, number of nets used and corresponding number of salmon caught. Supplementary information on surface temperature, light intensity, wind direction and force and wave hight were recorded on the research vessels. Besides, stomachs of salmon unsuitable for tagging from the "A.T. Cameron" cruise were brought back to the laboratory and examined with regard to food items occurring and weights of the various species. On the "Adolf Jensen" the stomach content of salmon were examined on board with respect to species occurrence.

Indices of effort

For the purpose of estimating abundance and/or availability of salmon in Greenland waters the only effort data available - apart from these produced by the observer and research vessels in the fishing season 1972 - are number of nets shot.

Fishing effort of drift-nets is among other things a product of the size of the net area (or total length of nets, when equally deep) and the duration of the fishing operation. A combination of the two factors: total length

of nets x fishing time can be obtained for the fishery carried out in connection with the tagging experiment. Introduction of the time factor in the indices of effort however may also introduce biases in the estimations of catch per unit effort, resulting in under- or overestimates of abundance. The reason is that effort changes with duration of fishing time and with the time of the day the nets are fishing. The strings of nets are usually set in straight lines, but after some time, depending on wind and current they will curve which in good weather may result in increasing catchability. In case of stormy weather the nets will even collapse and the consequence is decline of efficiency. Analyses of yield in relation to the time of the day nets are fishing suggest that generally the catches are decreasing after sunrise, and after 10 a.m. are less than 25 % of the early morning catches. Prolongation of nethauling during the day due to rough weather, entangled nets etc. consequently does not result in significant additional catches of salmon. Catch per unit effort of nets staying for a long period in the water will generally be underestimated.

Therefore, when analysing the effect of the various factors which are suspected to have an influence on catch per unit effort, duration of fishing as part of effort is not considered. As the only effort figures available from other years than 1972 are number of nets shot, this measure of fishing power is also adopted for the analyses of the 1972-data. It might be argued that the nets used by the commercial vessels were not quite uniform regarding length which suggest effort expressed as miles of nets to be a more appropriate indices of effort. Correlating number of nets shot with length of nets operated by weeks, areas and subareas however resulted in a correlation coefficient of $r = 0.9978$, which means that using number of nets as effort is justified.

In one instance, investigating inshore - offshore distribution by means of research and commercial catches effort is represented by miles of nets fished (Table 9 and 10). The reason is that the nets of the two categories of vessels are not equally long. Consequently the catch per research and per commercial net cannot be compared directly.

Fishing areas

The data of relevance for the present study, compiled from the commercial vessels and from the research vessels, are grouped in weeks, in areas along the West Greenland coast and in subareas defined by distances from the shore. The divisions are selected with special reference to an appropriate distribution of the salmon fishery on fishing grounds. The designations and the limits of areas and subareas (see Fig. 1) are the following:

Area I $70^{\circ}30'N - 68^{\circ}40'N$
Disko Bank and coastal bank west of Disko

Area II $68^{\circ}40'N - 66^{\circ}35'N$
Store Hellefisk Bank

Area III $66^{\circ}35'N - 65^{\circ}25'N$
Lille Hellefisk Bank

Area IV $65^{\circ}25'N$ - $6[illegible]35'N$
Sukkertoppen Bank and Fylla Bank

Area V $63^{\circ}35'N$ - $62^{\circ}00'N$
Fiskenæs Bank and Dana Bank

Area VI $62^{\circ}00'N$ - $60^{\circ}00'N$
Coastal Bank West and South of Arsuk

Subarea 1 Inside Baseline

Subarea 2 Baseline - 6-mile limit

Subarea 3 6-mile limit - 12-mile limit

Subarea 4 12-mile limit - 30-mile limit

Subarea 5 30-mile limit - 60-mile limit

A few shots of nets were made outside the divisions above. The corresponding salmon catches are referred to the Davis Str. and the Labrador Sea, north and south of latitude $60^{\circ}00'N$ respectively.

Results

Annual Distribution and Relative Abundance

During 1970 the catch and catch per unit effort data suggest that in all areas there was a general decline in the bi-weekly catch per unit effort as the season progressed. In Area II there was a decrease in catch/effort during the first half of August but it increased during the second half of August and then declined by approximately 75 % from August to November (Table 4). On the whole season the best catch/effort was obtained in ICNAF Division 1E followed by Divisions 1A, 1D, 1B and 1C (Table 4, Fig. 1).

During 1971 a similar pattern of seasonal catch decline is evident in all areas (Table 5). The overall catch per unit effort during 1971 was higher than in 1970 with the highest average catch rates occurring in Areas III, IV, V and VI. Catches in Areas I and II were somewhat lower but were approximately double those of 1970 for the respective areas. It must be emphasized, however, that the efficiency of each individual fishing operation doubled during the period 1968 to 1971 as a result of increased use of monofilament nets, progressive use of the most efficient mesh size, improved fishing techniques and general increase in crew skill and experience (Anon. 1973).

During 1972 in Areas II, III and V the catch rates declined steadily from August to October (Table 6). In Areas I, IV and VI, the catch rates were low during the first half of August and increased during the second half of August and also during the first half of September in Areas IV and VI after which they declined. The highest abundance, based on catch per unit effort data was in Area V followed by Areas III, IV, VI, I and II. The index of abundance in Area V was 2.7 times that in Area II.

The catch per unit effort during 1973 was lower than that during 1971 and 1972 and also possibly lower than that in 1970 bearing in mind the increased fishing efficiency of gear used in 1973. Catches in early July were low for areas where effort was expended but the catch/effort increased during the second half of July and early August in Areas II, III and V and decreased thereafter (Table 7). There was a small catch in Area I. In Area IV the catch/effort peaked during the second half of August and then decreased sharply. In Area VI the catch was low in proportion to the total catch. The catch rates were very good (44 to 78/100 nets) from late July to early September after which there was no effort in Area VI.

Inshore vs. Offshore Distribution and Abundance (1972)

In Area I during weeks 36-38 the best catches were obtained in subareas 1 to 4 (Tables 8, 9). During weeks 39-41 the best catch rates were obtained in subarea 5, i.e. offshore. Thus in Area I during 1972 there was a shift in distribution from inshore to offshore as the season progressed.

In Area II during weeks 33, 35-37 all catches were made in subareas 3 and 4 where catch rates were generally low except for week 33. Catches during weeks 38-41 indicate that where data is available the catch rates were fairly uniform through subareas 2-5 and were of a similar order of magnitude to those obtained in Area I during the same time period.

In Area III during week 32 the best catches were in subareas 3, 4 and 5 and lower in subarea 2. During weeks 33-36, 38 and 40 the catch per unit effort decreased from subareas 2-4 and as the season progressed there was an inverse relationship between catch rates and distance from shore. With the exception of week 32 the same general trend was evident from the research vessel data (Table 10).

In Area IV during week 32 there was an increase in catch/effort from subarea 2 to 4 and a marked decrease from subarea 4 to 5. In the remaining part of the season observer and research vessel data indicate that the catch rates decrease from inshore to offshore.

In Area V during weeks 33-35 there were rather high and uniform catches in all subareas fished. During the remainder of the season the observer and research vessel data suggest that smaller catches were obtained as the effort moved offshore.

In area VI there is too small amount of data to relate inshore and offshore catch rates.

In Davis Str., Labrador Sea and at East Greenland catches by commercial vessels during weeks 40 and 41 were very low (1-6 per 100 nets or 1.6-3.7 per miles of nets). On the other hand catches by research vessels in the southern Labrador Sea during weeks 33 and 35 were good (21.7 and 18.6 per miles of nets respectively).

Factors Affecting Abundance and/or Availability.

The average weights of food occurring in salmon stomachs were plotted against fishing areas using a least squares regression fit. Also for each subarea and week the catches of salmon/loo nets were plotted against the average weights of food in the stomachs of salmon. Similarly the results of the four research vessels were combined and the average salmon catches/loo nets were plottet against surface temperature, wind force and wave height using a least squares regression. The catch/loo nets versus wind direction during fishing was also analyzed to determine whether wind direction had any effect on the catch.

The most common items occurring in the stomachs of Atlantic salmon within the fishing areas at West Greenland were sand launce, capelin, amphipods, euphausiids and fish remains which again were probably mainly launce and capelin. In the Labrador Sea the main items of diet were Arctic squid Gonatus fabricii lanternfish, Paralepis coregonoides borealis, amphipods and fish remains (Table 11). There was a significant positive correlation ($r = 0.77$, $P < .02$) between average weights of food in stomachs of salmon and fishing area, i.e. the average weight of food/salmon increased from north to south (Fig. 2). A significant positive correlation also exists ($r = 0.61$, $P < .05$) between the number of salmon caught/loo nets and the average weight of food in the salmon stomachs (Fig.3).

There are also significant positive correl tions between the surface temperature and the average number of salmon/loo nets ($r = 0.37$) (Fig. 4), the wave height (n) and the average number of salmon/loo nets ($r = 0.66$) (Fig. 5). There was no significant correlation between the wind force and the average number of salmon/loo nets. Analysis of the catch per unit effort versus wind direction indicated that in general this parameter didn't appear to significantly alter the catch per unit effort of salmon when considered in light of the other factors.

Another factor which affect the catch rate and the abundance indices is the time of the day the nets are fishing, as already touched on. This is evidenced by results obtained on the A.T. Cameron during 1972 when records were kept of the numbers of salmon caught per each 2 hours interval during sets when the tagging boat was operating. These results are summarized in the following table.

Date		Set	4-6	6-8	8-1o	1o-12	12-2	Total
Aug.	11	186	-	13	o		o	13
"	13	188	-	23	13	2o	6	62
"	17	189	-	9	2	1	3	15
"	18	19o	-	17	5	12	7	41
"	19	191	11	7	7	5	3	33
"	2o	192	7	1	4	o	o	12
"	21	193	-	13	(8 - 12 caught 8)			21
"	28	196	-	2	1	o	o	3
"	29	197	-	7	3	2	1	13
"	3o	198	-	2	(8 - 2 caught 2)			4
"	31	199	-	o	o	o	-	o
Sept.	1	2oo	-	o	o	o	-	o
"	2	2o1	-	5	o	o	-	5
"	5	2o2	-	22	2	2	1	27
"	1o	2o3	-	2	o	o	o	2

Discussion

Atlantic salmon were reported to have been present at West Greenland during 1935 and 1936, especially in the autumn, about 2oo being caught in the autumn of 1935 (Jensen, 1939, 1948). This period was one of above average temperatures (Hermann, Lenz and Blacker, 1973) and it is quite possible that the occurrence of large numbers of salmon in Greenland at this time is associated with this warming trend. During 1969 the Canadian research vessel A.T. Cameron experienced the best salmon catches in Disko Bay and waters over Store Hellefisk Bank (May, 1973). Since 1969 there seems to be a trend developing toward a more southerly distribution of the salmon possibly as a result of the cooling trend evident along the West Greenland Coast (Hermann, Lenz and Blacker, 1973). For example, during 197o the salmon were fairly equally abundant in areas I to V and most abundant in Area VI. Salmon were most abundant in Areas III to VI during 1971, in areas III to VI during 1972 and in areas V to VI during 1973.

As regards the inshore vs.offshore distribution, in general, it may be stated that for 1972, the only year for which data are available, salmon were more or less equally abundant both inshore and offshore during early August in areas III, IV and V and during mid-August in areas III and V. Thereafter the salmon were more abundant inshore (inside the 12.mile limit). There was also a very dramatic decline in relative abundance as the season progressed. This seasonal decline was also evident in 197o, 1971 and 1973.

It must be noted that salmon were also very abundant, as evidenced by research vessel catches, in the mid-Labrador Sea during August. They were relatively much less abundant in Davis Str. Northern Labrador Sea, Umanak Fjord and East Greenland during September and early October.

There is a relationship between the feeding intensity of Atlantic salmon, expressed as weight of food/salmon, and fishing areas. Since the increase in abundance proceeds in the same direction along the West Greenland Coast as the increase in feeding intensity and also in view of the fact that the average number of salmon caught per 100 nets is directly proportional to the amount of food in salmon stomachs, it is a fair assumption to say that the distribution of food species in part accounts for the spatial distribution of salmon along the coast. Also since the number of salmon caught per 100 nets is directly proportional to surface temperature, it is quite possible that surface temperatures also plays both a direct and an indirect role in the salmon distribution and abundance in that it affects the distribution of the salmon themselves since salmon are known to be more abundant in surface temperatures of 3 to 6° (May, 1973) and also the limiting effect of temperature on the distribution, both vertically and along the coast, of the prey species of the salmon. These prey species are mainly sand launce, capelin, paralepidids and euphausiids although many other species are also of incidental importance to the diet of salmon at West Greenland (Lear 1972). The decline in salmon abundance after August, during 1972 may have been associated with a series of gales and deteriorating weather conditions during which the surface temperature decreased from 4.5° C to 2° C (Christensen, 1973).

Provided that salmon are present in an area, the availability to the gear is related to the wave height. Within the limits of wave conditions during which fishing was conducted by the research vessels, an increase in wave height tended to increase the salmon catch. This was often evidenced by a sudden increase in catch if the combination of wind and current increased the height of the waves from calm conditions to waves of 1 to 2 metres in height. The turbulence at the surface possibly decreases the light intensity such that the meshes of the nets are less visible. Possibly also the currents generated by wind and wave action may also activate feeding or orientation and this increased activity makes them more vulnerable to the gear. The wind force was not significantly correlated to catch per unit effort but in the light of the previous discussion it must be assumed to exert some influence. Data on wind force and salmon catches in the drift-nets fishery in the Baltic Sea revealed a non-linear relationship with highest catches at 3.5 Beaufort (Thurow, 1973). The direction of the wind appeared to have a very minor influence on the catch per unit efforts of the drift-nets. The wind direction has been noted to affect salmon catches in the Newfoundland-Labrador area where onshore winds tend to give increased catches and offshore winds tend to reduce the catches. This possibly also applies to the West Greenland set net fishery.

References

Christensen, O. 1973. The Danish salmon fishery at West Greenland in 1972. Int.Comm.Northw.Atlant.Fish.Res.Doc. 73/69 (also ICES/ICNAF Salmon Doc. 73/2o).

Hermann, F.,W. Lenz and R.W. Blacker. 1973. Int.Comm.Northw.Atlant.Fish. Redbook, Part III: 27-32.

Jensen, Ad.S. 1939. Concerning a change of climate during recent decades on the Arctic and subarctic regions, from Greenland in the West to Eurasia in the East, and contemporary biological and geophysical changes. Biol.Medd. Kbh., 14 (8): 1-75.

" , " " 1948. Contributions to the ichthyofauna of Greenland, 8-24. Spolia Zool.Mus.Hauniensis, 9: 1-182.

Lear, W.H. 1972. Food and feeding of Atlantic Salmon in coastal areas and over oceanic depths. Int.Comm.Northw.Atlant.Fish. Res.Bull. No. 9: 27-39.

May, A.W. 1973. Distribution and migrations of salmon in the Northwest Atlantic. International Atlantic Salmon Foundation, Spec.Publ.Series, 4 (1): 373-382.

Thurow, F. 1973. Local Movements of Salmon in the Baltic Sea. ICES, C.M. 1973/M:7.

Table 1. Catches at West Greenland, 1960-72, in metric tons, round fresh weight. (Based on data available at 31 March 1973).

	Drift-Net			Gill Net and Drift-Net		
Year	Norway	Faroes	Sweden	Denmark	Greenland[d]	Total
1960	0	0	0	0	60	60
1961	0	0	0	0	127	127
1962	0	0	0	0	244	244
1963	0	0	0	0	466	466
1964	0	0	0	0	1539	1539
1965	-[a]	36	0	0	825	861
1966	32	87	0	0	1251	1370
1967	78	155	0	85	1283	1601
1968	138	134	4	272	579	1127
1969	250	215	30	355	1360(385)	2210
1970	270	259	8	358	1244	2146[c]
1971	340	255	0	645	1449	2689
1972[b]	178	147	0	401	1306	2032

a - Figures not available, but catch is known to be less than Faroes.

b - Provisional.

c - Including 7 metric tons caught on long-line by one of two Greenland vessels in the northern Labrador Sea early in 1970.

d - Up to 1968, gill net only, after 1968 gill net and drift net. The figures in brackets for the 1969 catch are an estimate of the minimum drift-net catch.

Table 2. Number of vessels (excluding Greenland registered vessels) which have taken part in the West Greenland drift-net fishery 1965 - 72.

	Number of vessels				
Year	Denmark	Faroe	Norway	Sweden	Total
1965	0	1	1	0	2
1966	0	1	1	0	2
1967	4	4	3	0	11
1968	10	2	4	1	17
1969	15	6	11	2	34
1970	13	7	10	1	31
1971	11	3	8	0	22
1972	12	4	8	0	24

Table 3. Catches in metric tons, in the West Greenland home fishery 1963-72, until 1968 inshore gill-net fishery exclusively, since then in- and offshore drift-net fishery too.

ICNAF Div.	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972
1A	1	21	19	17	2	1	41	58	132	38
1B	172	326	234	223	205	90	396	239	254	136
1C	180	564	274	321	382	241	245	122	282	190
1D	68	182	86	207	228	125	234	123	262	543
1E	45	339	202	353	336	70	370	496	384	385
1F	-	107	10	130	125	34	-	207	135	118
Total	466	1539	825	1251	1278	561	1303	1267	1449	1410

Table 4. Distribution by ICNAF divisions and time of effort, catch and catch per unit effort in the salmon fishery with drift-nets at West Greenland 1970. The data comprise the fishery by 10 Danish vessels, i.e. 30 % of the total catch by vessels not registered in Greenland. (f = number of nets, C = number of salmon, C/f = number of salmon/100 nets).

Areas	ICNAF div.		July 16 - 31	August 1 - 15	August 16 - 31	September 1 - 15	September 16 - 30	October 1 - 15	October 16 - 31	November	Total per area
I	1A	f			500	31920	12934	960	450		46764
		C			127	13515	3211	102	45		17000
		C/f			25	42	25	11	10		36
II	1B	f	2932	21579	37324	4356	7266	11019	28176	25382	138034
		C	2035	4014	13997	1355	807	2523	8030	2478	35239
		C/f	69	19	38	31	11	23	29	10	26
III	1C	f	300	7916	3891	1367	237	2475	225	100	16513
		C	39	2455	1210	174	21	324	7	4	4234
IV		C/f	13	31	31	13	9	13	3	4	26
V	1D	f				300		2913	1724		4937
		C				150		1017	440		1607
		C/f				50		35	25		33
VI	[illegible]	f				5577	25372	2020		100	33069
		C				5426	19181	349		1	24957
		C/f				97	76	17		1	75
Total per half-months		f	3232	29497	41715	43520	45809	13387	30575	25582	239317
		C	2074	6469	15334	20620	23220	4315	8522	2483	83037
		C/f	64	22	37	47	51	22	28	10	35

Table 5. Distribution by areas and time of effort, catch and catch per unit effort in the salmon fishery with drift nets at West Greenland 1971. The data comprise the fishery by 9 Danish, 3 Faroese and 5 Norwegian vessels, i.e. 86 % of the total catch by vessels not registered in Greenland. (f = number of nets, C = number of salmon, C/f = number of salmon/100 nets).

Areas	Periods	August 1 - 15	August 16 - 31	September 1 - 15	September 16 - 30	October 1 - 15	October 16 - 31	November 1 - 8	Total per area
I	f		750	16520	14750	1600	1060		34680
	C		468	11796	9475	620	52		22411
	C/f		62	71	64	39	5		65
II	f	3280	25020	23665	25870	62166	22570	1500	164071
	C	1799	14897	13458	13985	40903	5454	213	90709
	C/f	55	60	57	54	66	24	14	55
III	f	67786	86783	15322	35681	18616	2400		226588
	C	55962	90224	14516	36523	6563	315		204103
	C/f	83	104	95	102	35	13		90
IV	f	6840	2305	4820		1100			15065
	C	7235	1811	4469		456			13971
	C/f	106	79	93		41			93
V	f	200	500	9295	4290	3700	200		18185
	C	18	162	9080	3140	2792	7		15199
	C/f	9	32	98	73	75	4		84
VI	f			8721					8721
	C			7535					7535
	C/f			86					86
Total per half-months	f	78106	115358	78343	80591	87182	26230	1500	467310
	C	65014	107562	60854	63128	51334	5828	213	353928
	C/f	83	92	78	78	59	22	14	76

Table 6. Distribution by areas and time of effort, catch and catch per unit effort in the salmon fishery with drift nets at West Greenland in 1972. The data comprise the fishery of 12 Danish, 4 Faroese and 6 Norwegian vessels, i.e. the total catch by vessels not registered in Greenland. (f = number of nets, C = number of salmon, C/f = number of salmon/100 nets).

Areas	Periods	August 1 - 15	August 16 - 31	September 1 - 15	September 16 - 30	October 1 - 15	October 16 - 31	Total per area
I	f	500	1064o	57453	315o1	5215		1o53o9
	C	73	5476	19283	4981	695		3o5o8
	C/f	15	51	34	16	13		29
II	f	2o62o	29286	24465	8375	1o7oo	12oo	94646
	C	1o265	7427	4431	862	967	111	24o63
	C/f	5o	25	18	1o	9	9	25
III	f	59o44	4413o	2ooo	2o56o	2ooo		127734
	C	353o9	1825o	221	2787	292		56859
	C/f	6o	41	11	14	15		45
IV	f	6o5o	1287o	1127o	6o8o	44oo	9oo	4157o
	C	2274	5106	6358	2595	1o85	255	17673
	C/f	38	4o	56	43	25	28	43
V	f	43o24	25oo4	49o8	1935o	13835	18oo	1o7921
	C	47548	15191	1476	4128	3989	249	72581
	C/f	111	61	3o	21	29	14	67
VI	f	1765	692o	7ooo	5529	4oo		21614
	C	32o	2191	3431	18o3	24		7769
	C/f	18	32	49	33	6		36
Total per half-months	f	131oo3	12885o	1o7o96	91395	3655o	39oo	498794
	C	95789	53641	352oo	17156	7o52	615	2o9453
	C/f	73	42	33	19	19	16	42

Table 7.

Distribution by areas and time of effort, catch and catch per unit effort in the salmon fishery with drift-nets at West Greenland 1973. The data comprise the fishery by 10 Danish, 4 Faroese and 4 Norwegian vessels. (f = number of nets, C = number of salmon, C/f = number of salmon/100 nets).

Areas	Periods	July 1 - 15	July 16 - 31	August 1 - 15	August 16 - 31	September 1 - 15	September 16 - 30	October 1 - 15	October 16 - 31	Total per area
I	f				2800	45423	8210	400		56833
	C				690	14713	962	8		16373
	C/f				25	32	12	2		29
II	f	650	1200	13885	47730	40960	56805	3000		164230
	C	14	623	4984	16088	12814	14026	395		48944
	C/f	2	52	36	34	31	25	13		30
III	f	4500	20680	53895	9480	9345	19130	55808	1380	174218
	C	642	9938	24804	2544	2985	4350	10721	162	56146
	C/f	14	48	46	27	32	23	19	12	32
IV	f	650	16450	12770	31100	7050	300	4375		72695
	C	6	4793	4337	9845	1653	21	876		21531
	C/f	1	29	34	32	23	7	20		30
V	f	200	19810	20300	26305	9450	200	360		76625
	C	95	12298	11621	12567	3976	3	5		40565
	C/f	47	62	57	48	42	2	2		53
VI	f		1150	4650	3400	2860	120			12180
	C		899	2036	2125	1873	7			6940
	C/f		78	44	63	65	6			60
Total per half-months	f	6000	59290	105500	120815	115088	84765	63943	1380	556781
	C	757	28551	47782	43859	38014	19369	12005	162	190499
	C/f	13	48	45	36	33	23	19	12	34

Table 8. Distribution by areas and time of effort, catch and catch per unit effort in the salmon fishery by drift-nets in Greenland waters in 1972. The data comprise the fishery by 12 Danish, 4 Faroese and 6 Norwegian vessels, i.e. the total catch by vessels not registered in Greenland. (f = number of nets, C = number of salmon, C/f = number of salmon/100 nets).

Week	no. dates	32 30.7.-5.8.		33 6.8.-12.8.		34 13.8.-19.8.		35 20.8.-26.8.		36 27.8.-2.9.		37 3.9.-9.9.		38 10.9.-16.9.	
Area	Subarea:	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5
I	f			500						23735		33873	440	10870	
	C			73						11805		11686	65	1298	
	C/f			15						50		35	15	12	
II	f			20620				8566		23350		10620		9915	1300
	C			10265				2108		6487		1874		1229	160
	C/f			50				25		28		18		12	12
III	f	20554	3480	19224	1680	34746		16190		7300				3200	
	C	15034	2485	9103	542	19784		4604		2007				300	
	C/f	73	71	47	32	57		28		28				9	
IV	f	1400	1300	1000	1450	1925		8590		5445		3880		5600	
	C	1008	206	208	576	751		3989		2404		2595		2183	
	C/f	72	16	21	40	39		46		44		67		39	
V	f	7220		17020		27850	100	15538	300			700		5308	
	C	2492		19297		32048	37	8781	84			168		1595	
	C/f	35		113		115	37	57	28			24		30	
VI	f	650		1115		220		900		7200		3840		2420	
	C	102		218		36		157		2840		1985		806	
	C/f	16		20		16		17		39		52		33	
Survey fishery other areas	f									300 Umanak fjord		80 Umanak fjord			
	C														
	C/f														
Total area I - VI	f	29824	4780	59479	3130	64741	100	49784	300	67030		52513	440	37313	1300
	C	18636	2691	39164	1118	52619	37	19639	84	25543		18308	65	7411	160
	C/f	63	56	66	36	81	37	39	28	38		35	15	20	12

Table 8. Continued.

Week	no. dates	39 17.9.-23.9.		40 24.9.-30.9.		41 1.10.-7.10.		42 8.10.-14.10.		43 15.10.-21.10.		44 22.10.-28.10.	
Area	Subareas:	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5	1-4	5
I	f	11000	880	8796	10000	3290	1925						
	C	1908	230	1220	1528	399	296						
	C/f	17	26	14	15	12	15						
II	f	3325	1200	1325	2525	7125	725	2850		300		900	
	C	351	125	110	276	674	65	228		11		100	
	C/f	11	10	8	11	9	9	8		4		11	
III	f	3340	6300	6770	2950	2000							
	C	385	1311	741	271	292							
	C/f	12	21	11	9	15							
IV	f	4180	300	1200		800		2600		1900			
	C	2151	43	219		126		681		533			
	C/f	51	14	18		16		26		28			
V	f	11850	1000	5400		5590	145	7000		2400		500	
	C	2587	20	1234		1831	9	1870		487		41	
	C/f	22	2	23		33	6	27		20		8	
VI	f	4180		689		400							
	C	1543		58		24							
	C/f	37		8		6							
Survey fishery other areas	f			2039 Davis Str.									
	C			51									
	C/f			3									
	f			1302 Labr. Sea		434 Labr. Sea							
	C			53		28							
	C/f			4		6							
	f			500 East Green- land		400 East Green- land							
	C			3		3							
	C/f			1		1							
Total area I - VI	f	37875	9680	24180	15475	19205	2795	12450		4600		1400	
	C	8925	1729	3582	2075	3346	370	2779		1031		141	
	C/f	24	18	15	13	17	13	22		22		10	

Table 9. Number of salmon caught per miles of commercial drift-nets fished in Greenland waters 1972 distributed on areas, subareas and weeks. Estimated on basis of effort and catch data of 8 commercial vessels.

Week no.		32	33	34	35	36	37	38	39	40	41	42	43
Area	Sub-area	30/7-5/8	6/8-12/8	13/8-19/8	20/8-26/8	27/8-2/9	3/9-9/9	10/9-16/9	17/9-23/9	24/9-30/9	1/10-7/10	8/10-14/10	15/10-21/10
I	1					31.6	15.2						
	2					34.9	21.2	7.5	5.7				
	3					35.8	22.4	5.2	0.4	3.7			
	4		8.8			11.7	19.7	4.5		3.8	4.8		
	5						8.9		14.3	11.3	9.9		
II	1												
	2							7.9			4.6		
	3		43.1		3.2	12.4	7.7	7.0			9.2		
	4		20.6		9.0	15.8	4.9	7.7	5.6	2.3		5.0	
	5							6.3		6.1	5.0		
III	1									22.1			
	2	14.7	36.5	40.7	21.7	19.7		11.4		7.9	8.6		
	3	40.3	32.2	42.3	16.0	4.7		4.4	3.3		16.3		
	4	39.8	30.1	25.1	11.4			4.4		5.2			
	5	39.8	17.6						13.2	5.5			
IV	1												
	2	17.5		20.3	39.7	11.8		15.1					
	3	27.3		26.9	7.5								
	4	58.7			5.7								
	5	11.3	22.3										
V	1		48.6					2.1	14.0				
	2		69.0	76.7	36.3			17.5	12.4	14.3	7.6	15.6	10.0
	3	16.2	21.1	53.9									
	4		48.2	50.1	54.4			18.0	1.3				
	5			20.8					1.1		3.6		
VI	1	9.1	8.5										
	2		12.6		8.2								
	3			8.3						1.2			
	4												
	5												
Davis Str.										1.6			
Labrador Sea										2.4	3.7		

Table 1o. Number of salmon caught per miles of research drift-nets fished in Greenland waters 1972 distributed on areas, subareas and weeks. Estimated on basis of effort and catch data of 4 research vessels.

Week no.		32	33	34	35	36	37	38	39	4o	41	42	43
Area	Sub-area	3o/7-5/8	6/8-12/8	13/8-19/8	2o/8-26/8	27/8-2/9	3/9-9/9	1o/9-16/9	17/9-23/9	24/9-3o/9	1/1o-7/1o	8/1o-14/1o	15/1o-21/1o
I	1					o.8							
	2							o.7					
	3		1.2	o.7									
	4												
	5							1.o					
II	1												
	2					o							
	3		1.6	2.7		1.3	8.9	4.4	3.2				
	4		37.2		2.o	4.3							
	5	16.1				1.o		4.3					
III	1												
	2												
	3	16.o		13.3	4.o			7.3					
	4		4.4					6.4					
	5	31.4				2.o							
IV	1						1o.o	4.6	8.o			13.o	5.o
	2		42.8	1o.o	13.3	3.5			4.7				
	3		7.5			1.3		3.8	1.3				
	4			13.7	11.4								
	5			5.o		1.3							
V	1			3.o	4.o					2.o			
	2			22.7	5.o		1.2		o				
	3		33.3	2o.7	3.3								
	4						o						
	5		o.7			1.2							
VI	1			14.7	33.o						6.o		
	2			1.3									
	3					4.4	4.o						
	4												
	5		12.2			11.2	4.5						
Davis Str.		1.6											
Labrador Sea			21.7		18.6								

Table 11. Occurrences of prey species in stomachs of Atlantic salmon caught by the research vessels A. T. Cameron and Adolf Jensen in the fishing areas at West Greenland and Labrador Sea, August-October, 1972

	AREA						
Species	I	II	III	IV	V	VI	LS
Empty	2	16	4	16	11	9	5
Fish remains		8	1	29	8	1	13
Mallotus villosus	4	4	19	76	15	57	
Lantern fish					3		19
Paralepis sp.		1	1				
Paralepis c. borealis				2		8	6
Gadus morhua	1				1		
Boreogadus saida						1	
Gaidropsarus argentatus							6
Ammodytes sp.	3	117	58	87	66	61	
Sebastes marinus				1			
Sculpin (unid.)				1		2	
Fish larvae (unid.)				1			
Gonatus fabricii					2	7	34
Polychaete worm				1		2	
Amphipod	3	30	3	38	4	10	12
Euphausiid	1	8	11	48		9	
Pasiphaea tarda							1
Shrimp (unid.)							1
Total no. of stomachs examined	8	147	76	177	90	115	46

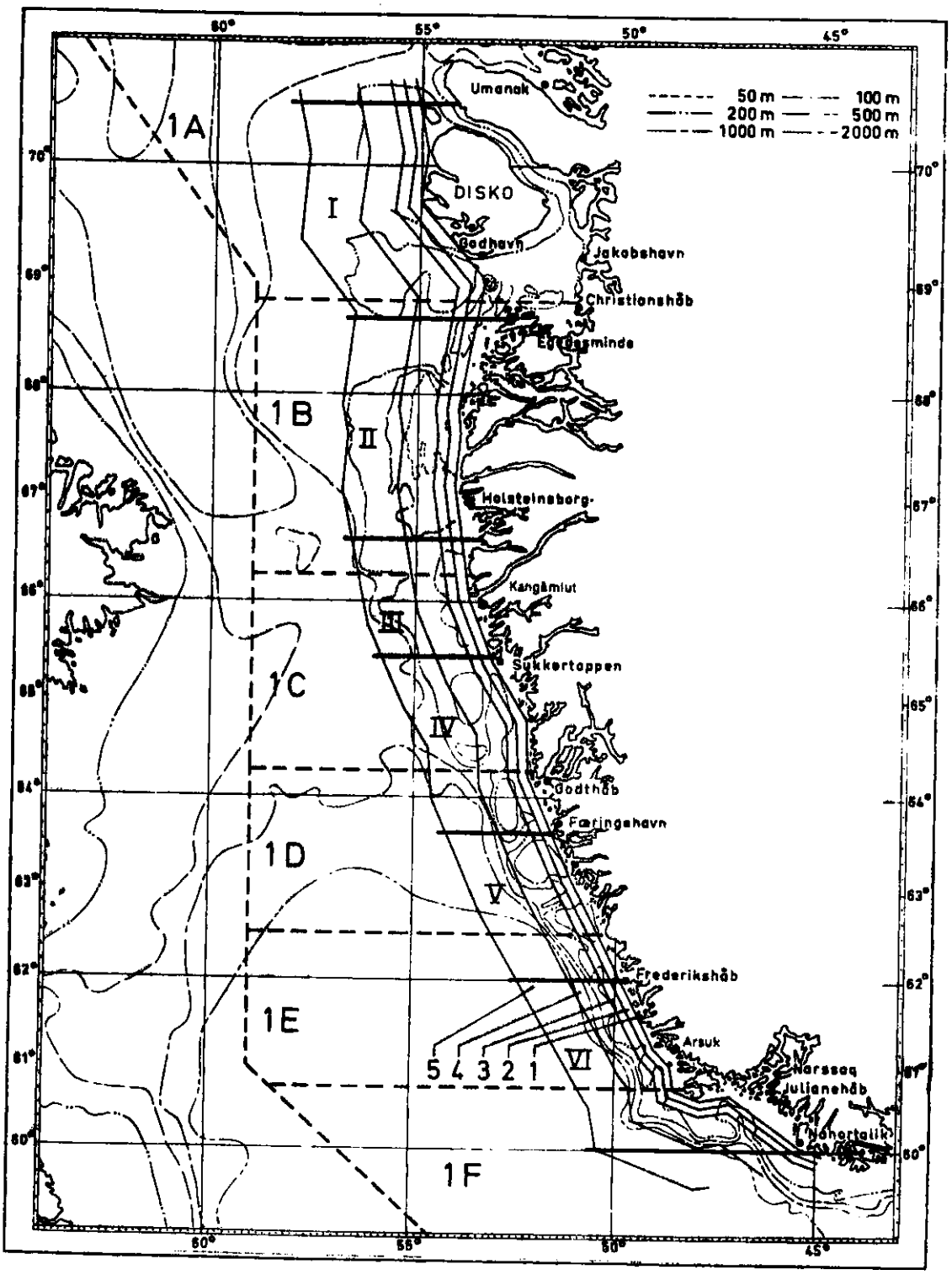

Fig. 1. Area map of West Greenland showing ICNAF divisions, fishing areas (I - VI) and subareas (1 - 5).

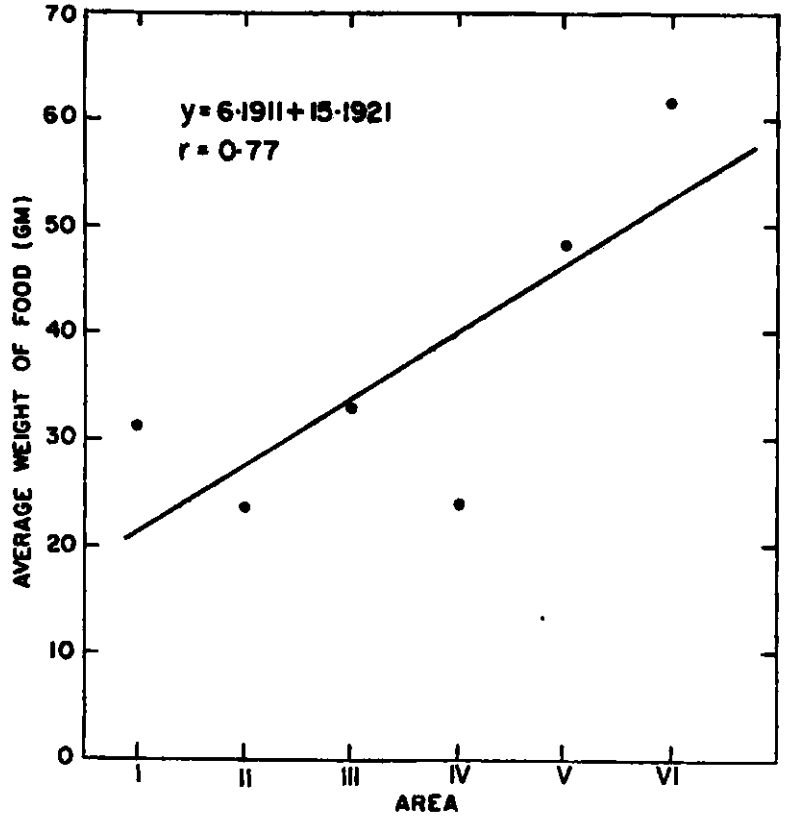

Fig. 2. Average weight of food in salmon stomachs versus fishing area based on data from A. T. Cameron cruise during 1972.

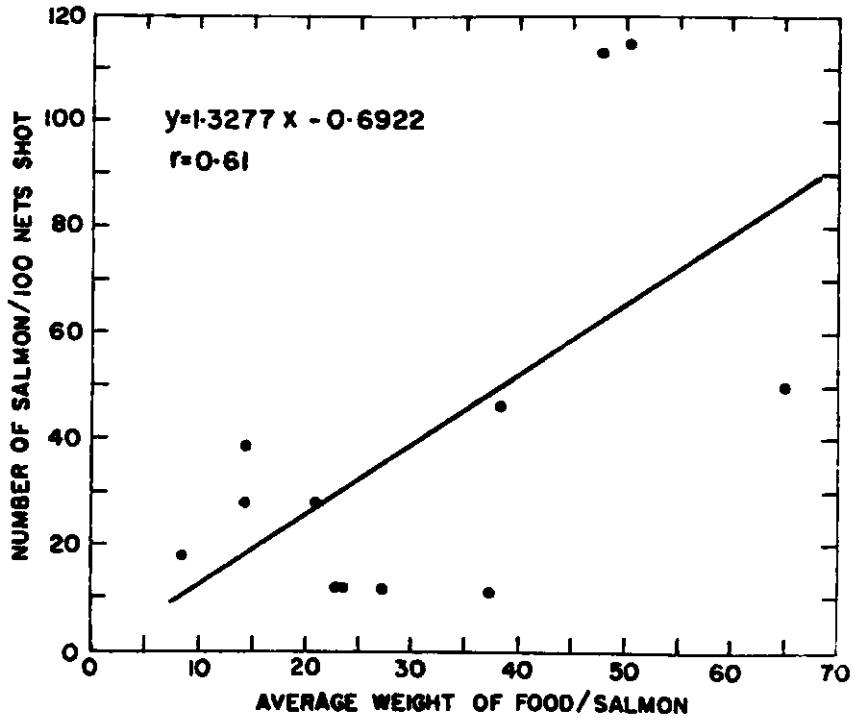

Fig. 3. Average number of salmon/100 nets caught by observer vessels plotted against the average weight of food found in salmon stomachs within the same subareas and weekly periods.

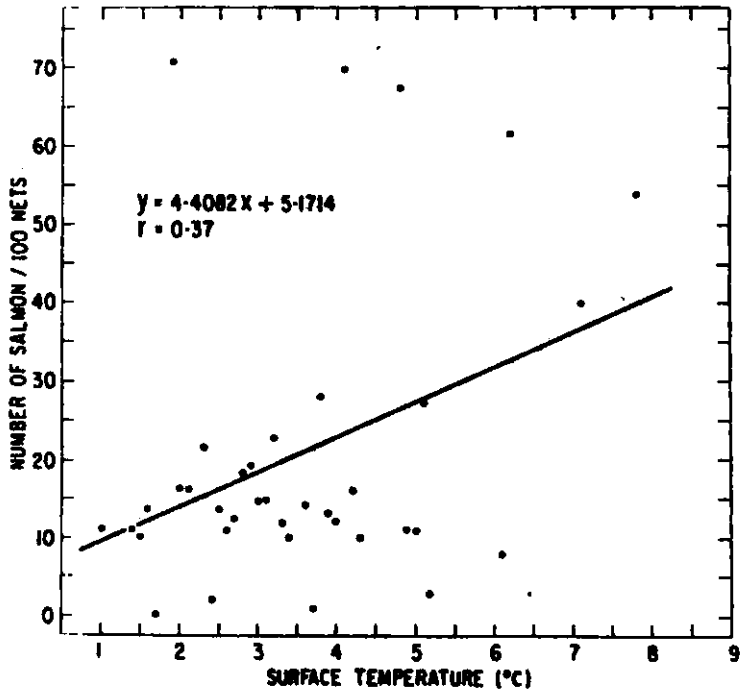

Fig. 4. Average number of salmon/100 nets versus surface temperature. Data from research vessel fishing.

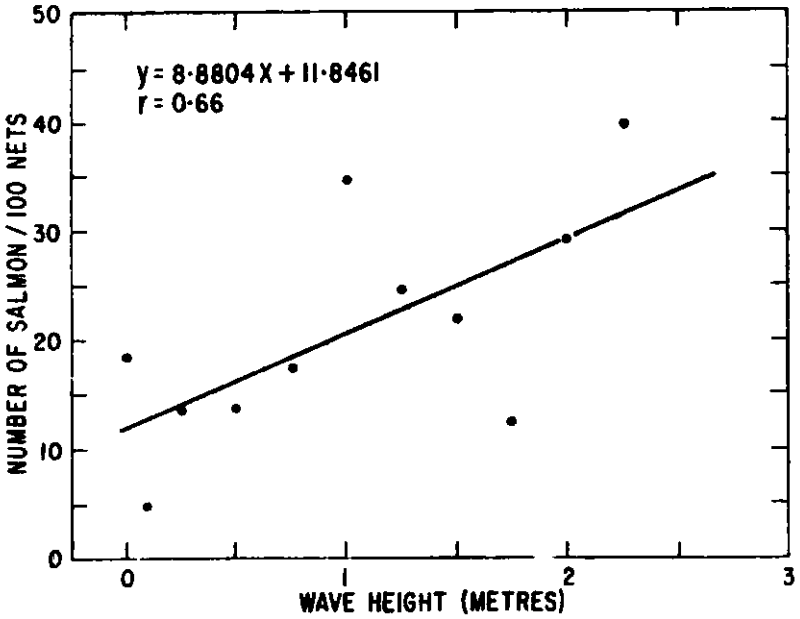

Fig. 5. Average number of salmon/100 nets versus the wave height (m). Data from research vessel fishing.