International Commission for the Northwest Atlantic Fisheries

Serial No. 4061
(D.c.9)

ICNAF Res.Doc. 76/XII/155

NINTH SPECIAL COMMISSION MEETING - DECEMBER 1976

Norwegian investigations on the deep sea shrimp (Pandalus borealis) in West Greenland waters

by

Ø. Ulltang and P. Øynes
Institute of Marine Research
Bergen, Norway

Publ. in ICNAF Sel. Papers No. 4: 35-42

1. Introduction

In 1971 Norwegian vessels started to take part in the West Greenland deep sea shrimp fishery. The fishery was successful and by 1975 there were 22 Norwegian vessels participating in the fishery. Many of the vessels and almost every member of the crew were the same as those which had been fishing for cod in Greenland waters in the years before 1969. The largest ships, 15 in all, came form the Møre districts in Norway and the rest from the Troms area. The latter had experience from the shrimp fishery in the Barents Sea. The conditions in the Greenland fields were quite different from what they were used to in Norwegian waters and in the Spitsbergen area and Barents Sea. In these fields they trawled over soft mud or sandy bottoms, while off Greenland they had to learn to trawl over much harder and rough bottoms. Compared to their home grounds the waters of Greenland contain smaller fields in the shrimp area where it is possible to trawl at all. In the Barents Sea one can trawl safely almost everywhere and find shrimps where the depths are suitable. In Greenland the loss or destruction of fishing gear is many times as high as in the home waters. It was the high density of shrimps in the Greenland waters that tempted the Norwegian fishermen to fish there.

Among Norwegian fishing vessels the ships that go to Greenland waters are relatively large. They are all refrigeration ships with a loading capacity of 70 to about 300 metric tons of frozen shrimps. The bulk have a capacity of between 80 and 120 tons.

The fishing gear they use is almost the same as was used in the Barents Sea: Sputnik trawls of 1600-1800 meshes with a ground rope of 41 or 51 meters length. The mesh size varies from 35 to 43 mm (stretched). Most ships use a 40 mm mesh size.

In 1976, 26 Norwegian ships are participating in the fishery. The main fishing grounds are shown in Figure 1. Most of the catches are taken on the continental slope off Store Hellefiskebank.

2. Investigations on the fishing grounds in 1976

From 13 July to 5 August one of the authors stayed on board the Norwegian shrimp trawler "PERO" as an observer. M/S "PERO" M28VD is a stern trawler of 575 tons, with a length of 154 feet. "PERO" is the biggest one of the Norwegian shrimp trawlers that fish at Greenland. "PERO" used two types of trawls, one was a 2200 meshes Wing trawl with a ground rope of 62 m and the other type was a 1800 meshes Sputnik trawl with a ground rope of 51 m. The Sputnik trawl is a much higher trawl than the Wing trawl. There seemed to be no significant difference in the fishing effectivness between the two types. The mesh size in all trawls used on "PERO" messured 43 mm. The cod end was taken in by the side of the vessel. On the deck the catch was dumped in a high tank of seawater which was dimentioned to take 3 tons of shrimps. In the tank the shrimps were kept alive by continuous flowing seawater. On the top of the tank was a grill to prevent bigger fish to come into the tank, and a hatch to float out the red fish and other floating fishes. The tank ended on the working deck where a hatch when opened washed the shrimps into a transport band which brought the shrimps directly to the sorting machines, one with 11 mm and the other with 8 $\frac{1}{2}$ mm split, which sorted the shrimps into "big" and "small" and sorted out the discards. After boiling and drying the shrimps were packed and then frozen in tunnels with a temperature of - 36°C for 16 hours, and afterwards stored in -20°C. The observer never saw the production stop from lack of shrimps, but it often stopped because one had to wait for the time to empty one of the three refrigerator tunnels. The freezing capacity on "PERO" was about 8 tons shrimps per day.

Table 1 gives data from the trawl hauls which were examined by the observer. The quantities of "big", "small" and discarded shrimps are given only in the cases when it was certain that there was no mixing of different hauls in the tank.

All catches are from the western slope of Store Hellefiskebank (Fig. 1).

3. Size composition of shrimps

THOMASSEN and ULLTANG (1975) have shown the effect of 30 and 35 mm mesh size in cod end on the size composition of shrimps in catches from Norwegian coastal waters. The difference of 5 mm in mesh size gave a big difference in the size of the shrimps. I could therefore be predicted that the 43 mm mesh size used by "PERO" would give very big shrimps. This is also the case. Table 2 shows the length composition in mm carapax length from some catches made by "PERO", Figure 2 shows length composition of random samples(from total catch including discards) from "PERO" compared with length of shrimps caught in the northern Barents Sea with 35 mm mesh size. The difference is remarkable. The top of the curve from "PERO" lies around 26 mm carapax length, while on the curve from the Barents Sea it lies around 19 mm. According to age/length data given by HORSTED and SMIDT (1956) the bulk of "PERO"s catch must be age groups IV and V, and most of the shrimps are fully mature females.

Fig. 3 shows the difference in length composition between the "big" and "small" shrimps. The "big" shrimps vary from 23 to 30 mm carapax length with the bulk around 26-27 mm. The "small" shrimps vary from 17 to 26 mm carapax length, with the top around 21-22 mm. This means that even the "small" shrimps from "PERO" are bigger then the shrimps fished in the Barents Sea. In Fig. 3 it is shown that the curve for discards follows the curve for the "small" ones. Most of the discards are soft shelled and crushed shrimps. The really small shrimps escape a trawl with 43 mm mesh size, and the quantities of discards will vary with the shrimps condition (i. e. whether they are soft shelled or not).

Table 1 gives total weight of discards for 8 hauls. These hauls gave a total production of 10976 kg shrimps (not including discards), of these were 8845 kg or 80,6 % "big" shrimps and 2131 kg or 19,4 % "small" shrimps. Total weight of discards were 1004 kg or 9,1 % of the production.

4. Bycatches

When using a trawl of mesh size 35-43 mm the bycatches will always be a problem. Table 1 shows the bycatches from some trawl hauls from M/S "PERO" in July and August. 1976. The fish are given as numbers of individuals and are exactly counted except for the red fish where the numbers are given in estimated thousands. When no figure is given in one of the columns for fish it means that there were no fish of the species. No fish were kept except those for consumption on board. The investigations included a total catch of 104484 kg shrimps (discards not included).

Bycatches are small compared to catches taken off the Norwegian coast and in the Barents Sea. M/S "PERO" caught only 577 cod among 104484 kg of shrimps. RASMUSSEN and ØYNES (1974) found on average 1 cod per kg shrimps in 22 hauls off Spitsbergen and in the Barents Sea.
The cod caught off Greenland were rather small (Fig. 4).

Since "PERO" fished on the continental shelf there were some Greenland halibut in the catches. The total number in the hauls examined was 7454 fish. A Greenland halibut has to be about 55 cm in total length to be taken for consumption in Norway. As seen from Fig. 4 very few reached that size and all were thrown overboard.

The only numerous fish in the bycatches were the red fish, sometimes in numbers up to about 10 000 per haul. All the red fish were very small, 10-20 cm long (Fig. 4). The red fish represent a considerable problem for shrimp trawling everywhere at high northern latitudes. RASMUSSEN and ØYNES (1974, Table 12) describe trawl hauls of 3 hours duration containing up to 69,000 red fish in the northern Barents Sea.
Other fishes in "PERO"s bycatches (Table 1) were long rough dab, blue whiting, catfish and 14 halibuts of 40-70 cm total length.

Compared with other shrimps fisheries it may be concluded that the bycatches represent no serious problem in the Greenland shrimp fishery at the moment.

5. Catch and catch per unit effort (CPUE)

In Tables 3-6 are given catch per hour trawling by ICNAF Division and month for 1975 and 1976. A weighted average catch per hour trawling for each division for each year is also given using the monthly catches as weighting factor. It may be disputed whether this is the best weighting factor to use, it was, however, decided to use this factor in order to get results comparable with HOYDAL (1976). The 1976 data are incomplete even for the first months of the year. Total catches for 1976 are estimated from an estimate of the total number of trips which will be made throughout the year and the mean catch per trip already reported.

Tables 3-4 show that the highest CPUE is obtained in Division 1 B (Holstein borg Dyb and west of Store Hellefiskebank). There is a lot of variation between months. In Division 1 B the highest CPUE is obtained in April-May.

There seems to have been some increase in CPUE from 1975 to 1976 with a mean increase of 27 % in Division 1 B (Table 5). It is not possible to determine whether this reflects an increase in abundance or higher efficiency due to better knowledge of the area resulting in for example fewer hauls with damaged gear and no catch (all hauls are included in the calculations).

The figures in Tables 3-4 include all reported catch and effort data. There is some variation in the size of the vessels, and allthough most of the vessels use the same type of trawl the towing speed may vary between 2 and 3 miles an hour and this may influence the catch per hour trawling. In Table 6 is given catch and catch per hour trawling for the largest trawler, M/S"PERO", for 1975 and 1976. "PERO" tows with a constant speed of 3 miles an hour. The catch per hour trawling is appreciable higher than the figures given in Tables 3-4. A comparison between 1975 and 1976 using the data in Table 6 can be made only for July and August for Div. 1 B. The data for these months indicate, however, an increase of at least the same size as the mean figure given in Table 5.

The catch data for M/S"PERO" in April-May 1976 were studied in a little more detail. In Figure 5 are shown the catches per hour trawling for each haul made during the second trip to the area (excluding hauls with damaged gear). The fishing started 29 April and ended 25 May. The high mean catch per hour trawling for the whole May (1.58 metric tons, Table 6) is mainly resulting from the extremely high catches during the period 1-10 May (Figure 5). The mean catch per hour trawling for the hauls between the two dotted lines in Figure 5 is 5.29 with a standard error of 0.48 metric tons. "PERO" fished during this period at various locations southwest of Store Hellefiskebank and at Holsteinborg Dyb, and the frequent shifts in location indicated on Figure 5 were probably due to reported difficulties with ice.

CPUE at West Greenland is remarkable high compared with other areas. STRØM and RASMUSSEN (1970) and RASMUSSEN and ØYNES (1974) reported a catch per hour trawling in the Barents Sea of 50-200 kg.

6. Stock size estimates based on catch per unit of effort

HOYDAL (1976) estimated the total stock of shrimps of fishable size on the offshore grounds to be 86 000 metric tons by calculating the area swept during one hour trawling and utilizing Faroese CPUE data for 1975. If it is assumed that the trawl effectively catches every shrimps in the area swept the stock size is estimated by

$$\frac{\text{Area of shrimp fishing grounds} \times \text{CPUE}}{\text{Area swept by the trawl}}$$

In the Table below are shown stock size estimates based on Norwegian data on catch per hour trawling in 1975 and 1976 using exactly the same method as HOYDAL (1976)

Stock size (S) estimates in metric tons

Method	S_{75}	S_{76}
Direct estimates from all Norwegian catch and effort data 1975 and 1976 (Tables 3-4)	79 000	110 000
Direct estimate for 1975, Stock size in 1976 assumed to be 25 % higher than estimated for 1975 (see Table 5)	79 000	99 000
Direct estimate from M/S "PERO"s CPUE in 1975 (Table 6). Stock size in 1976 assumed to be 25 % higher than estimated for 1975	102 000	127 000

The same total areas as assumed by HOYDAL have been applied (i. e. the areas given in HOYDAL's (1976) Table 2 and the additional area of 17 000 km^2 for which the CPUE in Div. 1 C was applied), and the area swept is calcucated for the same trawl (1800 meshes Sputnik trawl with a ground rope of 51 meters length) although some Norwegian vessels use a smaller trawl.

In the calculations based on all Norwegian vessels a mean towing speed of 2.5 miles an hour have been assumed. In the calculations based on data from M/S"PERO" the towing speed has been set to 3 miles an hour. This gives an area swept during one hour trawling of 0.139 km^2 and 0.167 km^2 respectively, assuming that a sector of 30 m width at average is swept by the trawl.

In the text table giving the stock size estimates, the stock size in 1976 is estimated both from the stock size in 1975 assuming 25 % increase from 1975 to 1976, and directly from the 1976 data. Of these two methods the first one is probably the best. The first method is based on the assumption that the increase in the average CPUE from 1975 to 1976 will be as observed for those months where reliable data exsists for 1976, while the second method is based on the assumption that the average CPUE in 1976 will be as observed for those months. Taking into account the seasonal variation in CPUE shown in Tables 3, 4 and 6, the first assumption is probably the safest. M/S"PERO"s CPUE data for 1976 could only give a direct estimate for Div. 1 B, and therefore only the first method is applied in this case.

HOYDAL (1976) lists several reasons for that estimates based on swept area must be considered as minimum estimates. Of the factors listed the following ones are perhaps the most critical.

1. It is assumed the the trawl effectively catches every shrimp in the area swept. This is hardly the case.

2. It is not taken into account that the vertical distribution of the shrimps may exceed the height of the headline of the trawl(It is for example an experience among the fishermen that the catches made just after sun set are low and that the best fishing time is just after sun rise in the morning. This is believed to be caused by vertical migrations of the shrimps).

It can, however, also be argued that the method in some cases may give an overestimate: It is assumed that within the different fishing grounds the fleet is distributed randomly with respect to shrimp density. If there are small local areas within a fishing ground with special high density of shrimps, and the fleet concentrates in these areas, the method could give an overestimate. It is known from the fishery at West Greenland that one or more vessels may fish for several days within a very small area, a vessel may indeed make haul after along the same track.[1] The reason for this is probably in most cases, however, that the bottom in the neigbouring areas is more rough, and the concentration of fishing activity in very small areas may thus have little or no connection with local variations in shrimp density. The authors therefore agree with HOYDAL (1976) that estimates based on swept area must be considered as minimum estimates.

As already poited out the increase in CPUE from 1975 to 1976 does not necessarly reflect that the stock size increased by a corresponding amount because there may have been some increase in efficiency. This does not, however, imply that one overestimates stock size by using the 1976 CPUE data. If the increase in CPUE merely reflects that one catches a given density of shrimps more effectively in 1976 by for example avoiding too rough bottom the relative size of the 1976 stock compared to the 1975 stock will be overestimated. The stock size in absolute numbers, however, will still be underestimated because a 100 % efficiency in catching the shrimps present in the area swept is assumed.

If, however, the increase in CPUE reflects better ability to find the highest concentrations of shrimps there could be a danger for overestimating stock size by using the 1976 data. The posibility that the fleet concentration more local high densities of shrimps has already been discussed.

The discussion above will also cover the question whether one should use estimates based on the most efficient vessels or all vessels. Under one set of assumptions it may be argued that both estimates is biased downwards, which implies that the estimates based on the most efficient vessels is "best" (in our case the estimates based on "PERO"s CPUE), under the other set of assumptions the use of the most efficient vessels may lead to an overestimate.

---

1) The observer on board "PERO" counted 26 trawlers fishing almost along the same track for more than a week west of Store Hellefiskebank

One critical factor using the swept area method is the assumptions made about the size of the areas with shrimp concentrations. To get further knowledge here one has to carry out bottom trawl surveys covering all areas where shrimps may exist in substantial quantities. Because it is positively known that shrimp concentrations exist in the areas applied in the calculations done in this paper an underestimation of stock size is again the most likely effect. The stock size estimates would increase substantially if one included all areas with suitable depth for the shrimps in the calculations.

The size of the concentrations fished on by M/S "PERO" in the beginning of May 1976 (Figure 5) may be estimated by the swept area method by applying M/S "PERO"s mean catch per hour trawling in the actual period on an area covering the fishing grounds southwest of Store Hellefiskebank and tat Holsteinborg Dyb (Figure 1). This area is roughly estimated to 3900 km^2, and a mean catch per hour trawling of 5.3 metric tons (see section 5) will then give an estimate of these concentrations of about 124 000 metric tons. This estimate supports the reasons already given for that HOYDAL's (1976) estimate and the estimates given in this paper are underestimates because shrimps in May probably occurs in substantial quantities also outside the limited area covered.

REFERENCES

HORSTED, Sv. Aa. and SMIDT, E. 1956. The Deep Sea Prawn (Pandalus borealis Kr.) in Greenland Waters. - Medd. Danm. Fisk. - og Havundersg. 1 (11): 1-118.

HØYDAL, K. 1976. An assessment of the deep sea shrimp (Pandalus borealis) in West Greenland waters. ICNAF Res. Doc. 76/VI/15:1-5. [Mimeo.]

RASMUSSEN, B. and ØYNES, P. 1970. Forsøksfiske etter reker. Barentshavet i mars-april 1970. Fiskets Gang, 56: 587-593.

RASMUSSEN, B. and ØYNES, P. 1974. Forsøk med reketrål som sorterer bort fisk og fiskeyngel. Fiskeridirektoratet. Fiskerinæringens Forsøksfond, Rapp. (4): 3-15

STRØM, A. and RASMUSSEN, B. 1970. Forsøksfiske etter reker i Barentshavet og Svalbardområdet juni-august 1970. Fiskets Gang, 56: 912-917.

THOMASSEN, T. and ULLTANG, Ø. 1975. Report from mesh selection experiments on Pandalus borealis in Norwegian Waters. ICES, C. M. 1975/K:51 [Mimeo.].

Table 1. Total catch of shrimps and bycatch of fish from some trawl hauls made by M/S "PERO" at West Greenland in July/August 1976

St.	Date	Time	Position	Hauling period	Shrimp catch in kg				Bycatch in number of individuals			
					Total	Large	Small	Discards	Cod	Greenl. Hal.	Red fish	Others
1	13/7	1815	N 66° 57' V 56° 21'	2 hrs. 20 mins.	750					200	1000	A few
2	14/7	0505	N 66° 48' V 56° 20'	2 hrs. 20 mins.	1408	1144	264	132	110	265	770	103
4	"	1130	" "	2 hrs. 20 mins.	1492	1360	132	176	36	168	803	50
5	"	1520	" "	2 hrs. 30 mins.	1600				13	155	660	42
6	15/7	0815	N 66° 44' V 56° 15'	2 hrs. 30 mins.	900				16	142	610	131
7	"	1115	" "	2 hrs. 20 mins.	880	748	132	100		112		76
9	"	1815	" "	50 mins.	10						Much	1
10	16/7	0615	N 67° 16' V 56° 40'	2 hrs.	748	660	88	60	18	44	1500	43
11	"	0915	" "	2 hrs. 15 mins.	1000				16	53	2500	58
12	"	1245	" "	2 hrs. 30 mins.	1200				7	91	7100	46
13	"	1650	N 67° 06' V 56° 45'	2 hrs. 15 mins.	1650					944	300	64
14	17/7	0905	N 67° 11' V 56° 20'	2 hrs.	1628	1210	418	176	6	21	1150	23
15	"	1150	" "	2 hrs. 30 mins.	1144	864	280		7	24	1000	13
16	"	1525	N 67° 03' V 56° 15'	2 hrs. 30 mins.	3000				5	30	700	16
17	18/7	0700	N 67° 11' V 56° 20'	2 hrs.	800				20	18	400	21
18	"	1000	" "	2 hrs.	1386	1024	362		9	47	3000	46
19	"	1325	" "	2 hrs. 35 mins.	650				2	12	1000	23
20	"	1640	N 67° 11' V 56° 35'	1 hr. 40 mins.	1804	1364	440			39	600	19
21	19/7	0810	" "	2 hrs.	2000				2	50	2500	55
22	"	1100	" "	2 hrs. 5 mins.	1870					48	2400	24
23	"	1430	" "	2 hrs.	2200	1700	500	200	6	59	2000	39
24	20/7	0755	" "	2 hrs.	924	748	176		4	50	3000	32
25	"	1115	N 67° 11' V 56° 40'	2 hrs.	1122	902	220		6	82	2000	22
26	"	1420	" "	2 hrs. 20 mins.	1826	1474	352		3	258	2000	48
27	"	1805	N 67° 12' V 56° 15'	2 hrs.	1350				5	124	2000	13
28	21/7	0740	N 67° 12' V 56° 50'	1 hr. 40 mins.	1584	1276	308		5	152	2000	18
29	"	1045	N 67° 12' V 56° 43'	2 hrs.	2266	1760	506		9	210	1000	33
30	"	1340	" "	2 hrs. 20 mins.	2376	1870	506		17	222	3000	27
31	"	1710	N 67° 12' V 56° 15'	1 hr.	600				3	81	700	24
32	22/7	0630	N 67° 11' V 56° 40'	2 hrs. 30 mins.	1408	1122	286		23	94	2000	24
33	"	0955	" "	2 hrs. 40 mins.	2046	1606	440		56	116	2500	16
34	"	1400	" "	2 hrs. 30 mins.	1300	1011	289	72	24	79	3500	12
36	23/7	0720	" "	2 hrs. 15 mins.	1900				2	39	3200	44
37	"	1110	" "	2 hrs. 15 mins.	1452	1122	330			82	4800	26
38	"	1445	" "	1 hrs	704	528	176		Not counted			
40	24/7	0640	N 67° 15' V 56° 42'	2 hrs. 30 mins.	1320	1012	308	88		78	3000	2
41	"	0935		2 hrs. 10 mins.	1056	836	220		3	48	6-7000	10
42	"	1250	N 67° 13' V 57° 01'	2 hrs. 30 mins.	1518	1258	260			75	2040	39
43	"	1640	" "	2 hrs. 15 mins.	1200				3	111	3000	50
44	25/7	0555	N 67° 02' V 56° 35'	2 hrs. 10 mins.	946	770	176			364	5000	2

Table 1. continued

45	"	1000	N 67° 02' V 56° 38'	2 hrs. 15 mins.	264	220	44		34	ca. 10000	26
46	"	1340	" "	2 hrs. 20 mins.	660	572	88	1	26	ca. 5000	14
47	"	1700	" "	2 hrs. 30 mins.	600				38	3000	21
48	26/7	0800	N 67° 03' V 56° 45'	2 hrs.	1340				320	1200	5
49	"	1200	" "	2 hrs. 30 mins.	2112	1848	264		240	300	16
50	"	1520	" "	2 hrs. 15 mins.	1750				153	200	9
51	27/7	0555	N 67° 06' V 57° 00'	2 hrs. 30 mins.	2772	2376	396		136	150	2
52	"	0940	" "	2 hrs. 30 mins.	1892	1672	220		173	200	0
53	"	1350	" "	2 hrs.	1584	1452	132		172	150	1
54	"	1710	" "	2 hrs. 15 mins.	1380				322	150	5
55	28/7	1025	" "	2 hrs. 15 mins.	1850	1674	176		81	100	3
56	"	1420	" "	2 hrs. 35 mins.	1474				141	300	5
57	29/7	0755	N 67° 04' V 57° 00'	2 hrs. 30 mins.	2254	2166	88	1	34	3000	9
58	"	1415	" "	2 hrs.	528	474	54		26	500	
59	"	1730	" "	2 hrs. 20 mins.	1000				148	200	
60	30/7	0650	N 67° 06' V 57° 00'	1 hr. 50 mins.	836	796	40		61	310	7
61	"	0935	N 67° 08' V 57° 00'	1 hr. 25 mins.	880	840	40		18	300	5
62	"	1145	" "	2 hrs.	616	506	110		Not counted		
63	"	1505	" "	1 hr. 30 mins.	1320	1232	88		46	600	14
64	"	1730	" "	1 hr.	528				43	300	13
65	31/7	0710	N 67° 05' V 56° 58'	2 hrs.	792				98	100	1
66	"	1025	" "	2 hrs. 30 mins.	1000				66	150	
67	"	1405	" "	2 hrs. 10 mins.	1056	880	176		90	500	1
68	"	1715	" "	2 hrs.	900				139	100	14
69	1/8	0640	N 67° 09' V 56° 58'	1 hr.	616	528	88		1	3000	1
70	"	0910	" "	2 hrs.	1628	1507	121		11	5000	1
71	"	1215	" "	2 hrs.	946	880	66		8	7000	5
72	"	1525	" "	2 hrs.	902	858	44		35	5000	3
73	2/8	0640	" "	1 hr. 40 mins.	4500				1	4000	
74	"	1120	" "	1 hr. 15 mins.	4500					8000	
75	"	1640	" "	1 hr.	2400				1	7000	1
76	3/8	0940	N 67° 48' V 58° 13'	35 mins.	130				3 + 44 fry	3000	11
77	3/8	1135	" "	1 hr. 30 mins.	1056	858	198		1 + 40 fry		1
79	"	1915	N 67° 32' V 58° 22'	1 hr. 30 mins.	2700				1 + 36 fry	4000	
80	4/8	1200	N 67°32' V 58° 19' - N 67° 38' V 57° 50'	40 mins.	700	634	66			6000	

Table 2. Length compositions of shrimps caught by M/S"PERO" in July/August 1976

		Length (mm carapax)																					
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Random samples from the catch	St 1							2	2	9	15	33	27	16	15	43	44	31	22	1			
	St 2							4	5	15	32	53	49	26	22	54	36	25	9	4			
	St 9								10	14	23	51	45	21	19	34	25	32	9				
	St 10					1	2	3	2	9	13	18	16	12	18	43	62	45	8	1	1		
	St 13							1	6	8	8	13	23	11	12	42	56	60	22	6	1		
	St 15							4	12	12	14	32	18	10	25	24	49	23	6	1			
	St 20						4	2	7	4	13	24	22	11	28	40	36	31	12	3	1		
	St 26	1			1	1			2	10	9	18	27	13	14	45	54	27	11	1			
	St 34							2	3	5	6	14	18	11	15	34	58	31	14				
	St 72					1			2	5	7	11	7	8	7	25	49	46	42	7	1	1	
Total		1			1	3	6	18	51	91	140	267	252	139	175	384	469	351	155	24	4	1	2532
%		0			0	0,1	0,2	0,7	2,0	3,6	5,5	10,5	10,0	5,5	6,9	15,2	18,5	13,9	6,1	0,9	0,2		99,8 %
"Big" shrimps	St 15									2	1	3	5	6	10	23	41	35	8	1			
	St 49										1	3	8	8	17	36	61	60	36	11	3		
	St 72									1			4	1	3	11	37	52	33	8	1	1	
Total										3	2	6	17	15	30	70	139	147	77	20	4	1	531
%										0.6	0.4	1.1	3.2	2.8	5.6	13.2	26.2	27.7	14.5	3.8	0.8	0.2	100.1 %
"Small" shrimps	St 15								1	12	21	37	43	12	5	10	5	1					147
	%								0.7	8.2	14.3	25.2	29.3	8.2	3.4	6.8	3.4	0.7					100.2 %
Discards	St 1						1	1	8	11	28	43	42	24	9	4	4						175
	%						0.6	0.6	4.5	6.3	16.0	24.6	24.0	13.7	5.1	2.3	2.3						100.1 %

Table 3. Catch and catch per hour trawling, 1975

Month	Division 1 A Catch	1 A CPUE	1 B Catch	1 B CPUE	1 C Catch	1 C CPUE	1 D Catch	1 D CPUE	1 E Catch	1 E CPUE	Total catch reported from Subarea 1
1					4	0.20	32	0.221			36
2			21	0.206	140	0.237	126	0.257			287
3			43	0.297	143	0.194	86	0.208	2	0.2	274
4			717	0.869	3	0.25	4	0.308			724
5			461	1.11	24	0.20					485
6			217	0.371	136	0.255	232	0.237			585
7			1485	0.504	116	0.208	86	0.396			1687
8			792	0.438			23	0.169	2	0.167	817
9	58	0.319	373	0.237	26	0.184	85	0.243			542
10	17	0.378	1425	0.657	10	0.156	82	0.225			1534
11			579	0.431			5	0.128			584
12			221	0.442							221
Unspecified											902
Total	75		6334		602		761		4		8678
Weighted average CPUE		0.332		0.584		0.260		0.251			

Table 4. Catch and catch per hour trawling, 1976 (preliminary data)

Month	Division 1 B Catch	1 B CPUE	1 C Catch	1 C CPUE	1 D Catch	1 D CPUE	Total catch reported from Subarea 1	Estimated catch for the whole year
1	174	0.619	84	0.449	73	0.257	331	
2	514	0.821	33	0.266	52	0.274	599	
3	1	0.2	108	0.243	180	0.270	289	
4	621	0.972	156	0.398	125	0.179	902	
5	1647	1.447					1647	
6	675	0.576			1	0.167	676	
7	921	0.492	14	0.259	8	0.421	943	
8	682	0.414					682	
9	281	0.408					281	
10	6	0.273					6	
Total	5522		395		439		6356	12 000
Weighted average CPUE		0.862		0.351		0.245		

Table 5. Ratio between catch per hour trawling in 1976 and 1975 (only month and areas with at least a catch of 50 metric tons each year included)

Month	Division		
	1 B	1 C	1 D
1			
2			
3		1.25	1.30
4	1.12		
5	1.30		
6	1.55		
7	0.98		
8	0.95		
9	1.72		
10			
11			
12			
Mean	1.27		

Table 6. Catch and catch per hour trawling, M/S "PERO" 1975 and 1976

Month	1975						1976				1976 CPUE/CPUE 1975
	1 B		1 C		1 D		1 B		1 D		1 B
	Cath	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	Catch	CPUE	
1							32	1.03			
2	3	0.094			41	0.279	108	0.90			
3	11	0.367	3	0.231	10	0.250			29	0.248	
4							15	1.15			
5							310	1.58			
6			20	0.606	4	0.267					
7	148	0.488	6	0.353			211	0.619			1.27
8	79	0.449					79	0.712			1.59
9	9	0.243									
10	223	1.057									
11	65	0.392									
12											
Total	538		29		55		755		29		
Weighted average CPUE	0.698		0.515		0.273		1.09		0.248		

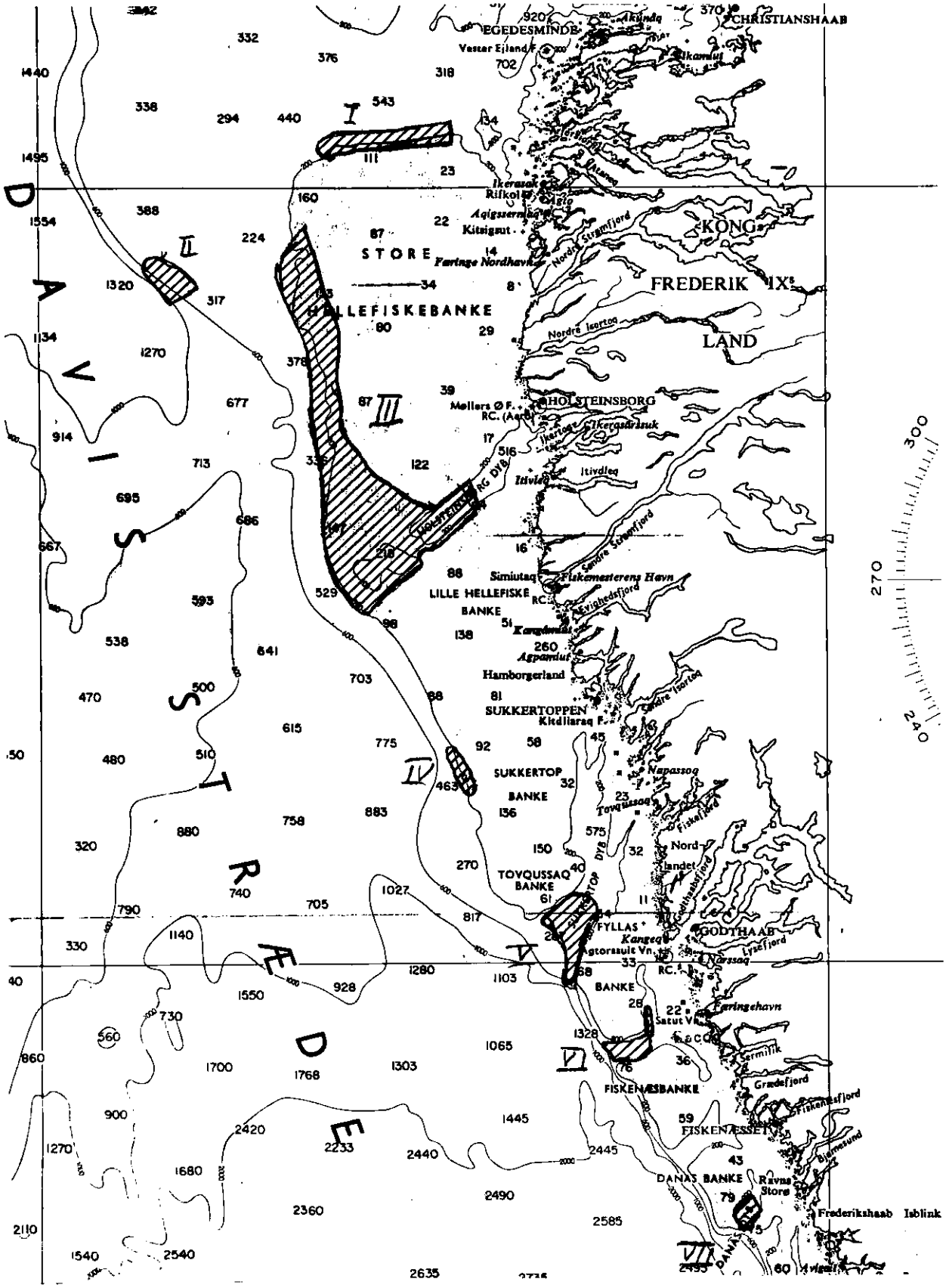

Fig. 1: The main areas fished by the Norwegian shrimp trawlers at West Greenland. I: Southwest of Disko Bugt. II and III: The slope of Store Hellefiskebanke and Holsteinborg Dyb. IV: The slope of Sukkertop Banke. V: Sukkertop Dyb. VI: Godthåp Dyb. VII: Danas Dyb.

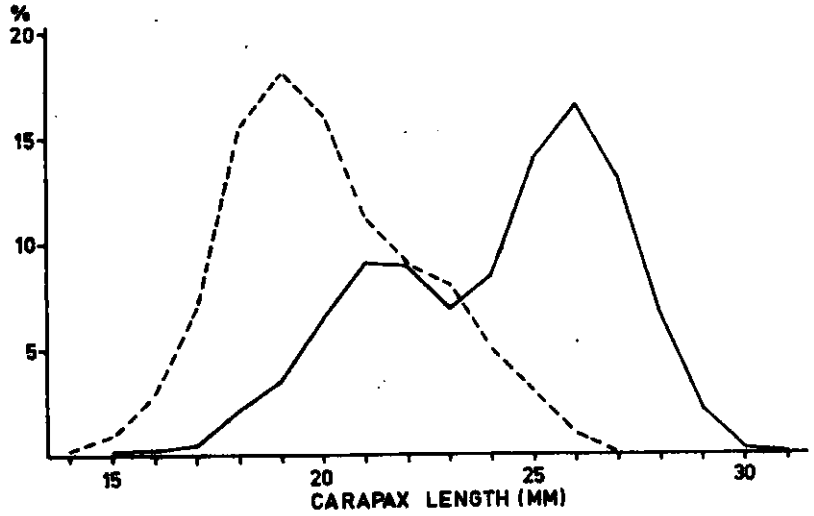

Figure 2: Length composition (mm carapax length) of shrimps caught by M/S PERO July/August 1976 (3 point moving average)
For comparison is shown a typical length composition from the northern Barents Sea (broken line)

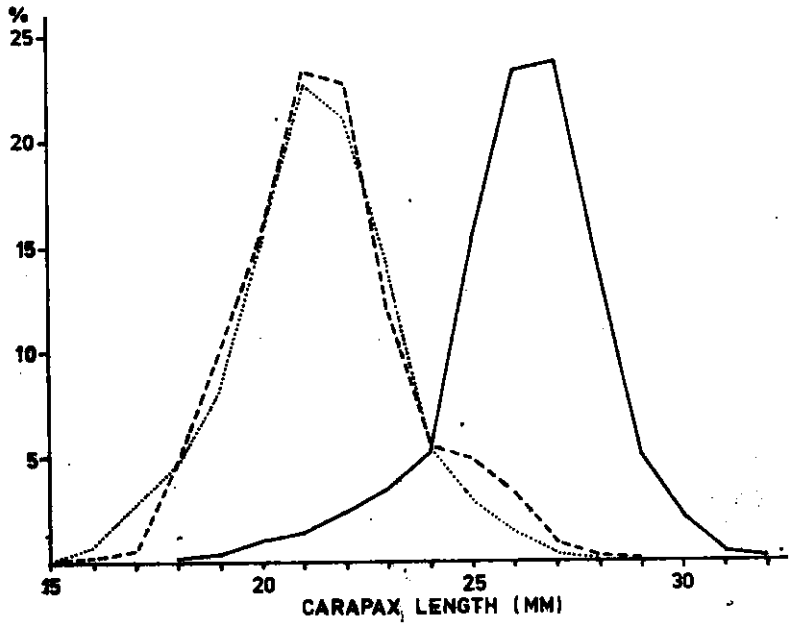

Fig. 3. Length composition (mm carapax length) of "big", "small" and discarded shrimps caught by M/S PERO July/August 1976 (3-point moving average)

——— "big" shrimps
- - - - - "small" shrimps
..... discards

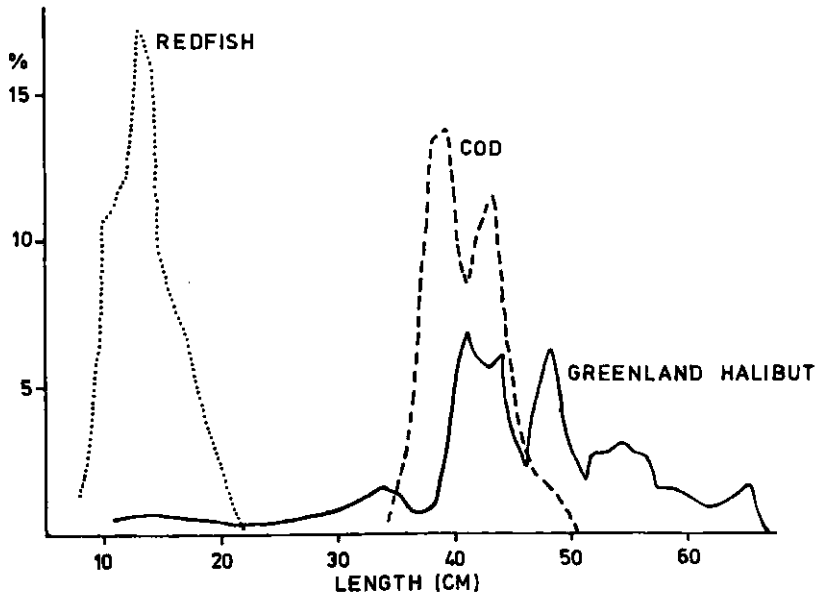

Figure 4. Length composition of bycatches of redfish, cod and Greenland halibut. M/S PERO July/August 1976.

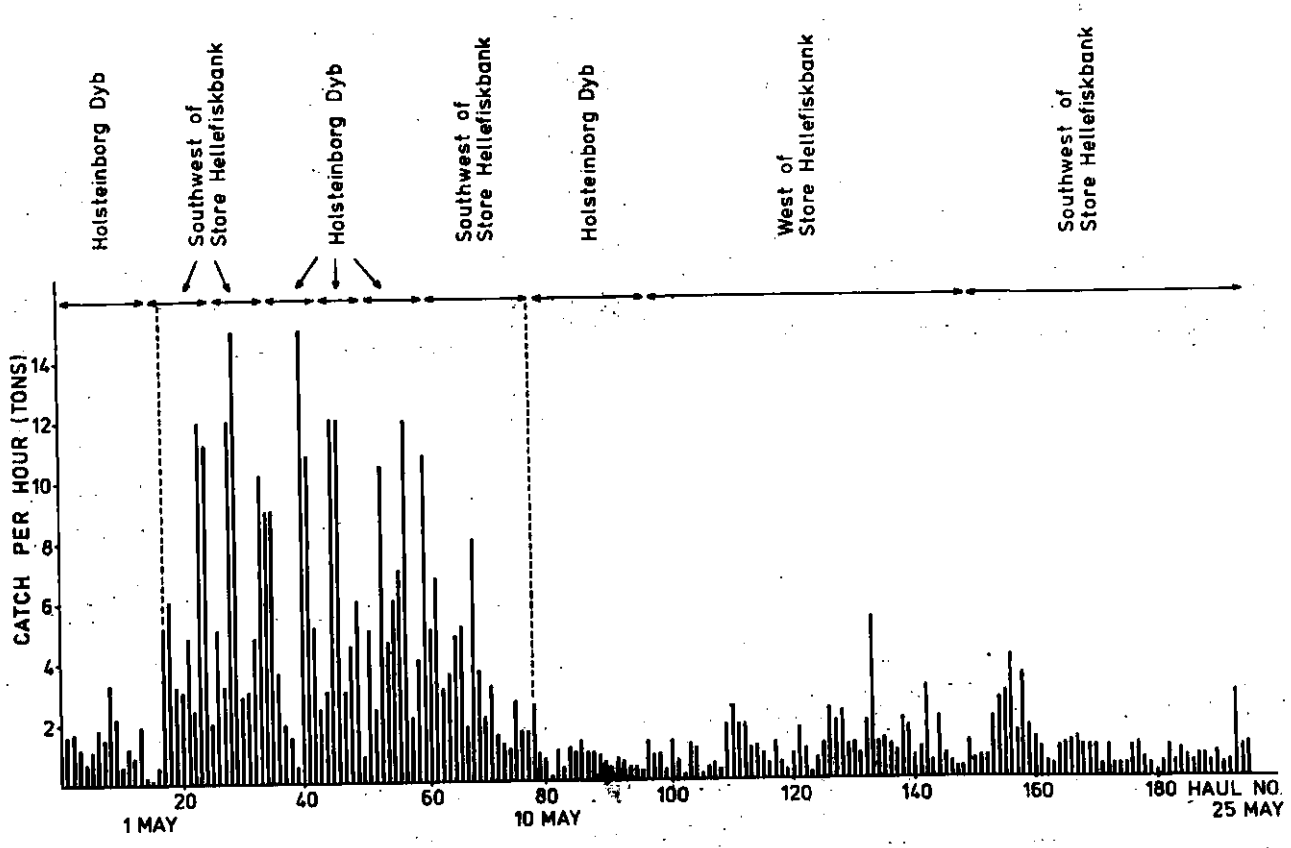

Figure 5. Catch per hour trawling in each haul made by M/S PERO during its second trip 1976. Hauls within a ⟷ are taken at approximately the same position.