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Results of stratified trawl surveys for shrimps (Pandalus borealis) in the Barents Sea in and the Svalbard region in 1986.

by

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#### ABSTRACT

The results of a stratified random bottom trawl survey with R/V "Michael Sars" in April - May 1986 in the Barents Sea between  $N71^{\circ}30'$  -  $N75^{\circ}30'$  and between  $E22^{\circ}00'$  -  $E35^{\circ}30'$  is described in this report. The northern part of the Barents Sea between  $N75^{\circ}30'$  -  $N76^{\circ}35'$  and between  $E25^{\circ}30'$  -  $E35^{\circ}00'$  was surveyed in July 1986. The Svalbard region between  $N73^{\circ}00'$  -  $N80^{\circ}30'$  and between  $E08^{\circ}00'$  -  $E25^{\circ}30'$  was surveyed in July-August 1986.

Based on data from 146 trawl stations, the biomass of shrimps in the Barents Sea survey was estimated to about 159 000 tonnes. In the Spitsbergen area the biomass was estimated to about 22 000 tonnes, calculations based on data from 90 trawl stations. By-catch data for fish is also given.

## INTRODUCTION

A stratified random bottom trawl survey was carried out in the Barents Sea from 23 April to 18 May and from 16 July to 13 August in the Bear Island and Spitsbergen area. The objectives of the surveys were to study the abundance and structure of the shrimp stocks and measure the by-catches of fish species.

## MATERIAL AND METHODS

The trawl used was a "Campelen Super" 1800 meshes shrimp trawl with 12-21 inches rubber bobbins. The mesh size is decreasing from 80 mm in the front part to 35 mm in the codend, lined inside with a net of 4 m in length and 8 mm mesh size. The sweep wire was 40 m. The trawling distance on each station was 3,0 nautical miles at a speed of three knots/hour. During the towing the horizontal opening of the trawl was calculated to be 11,7 m (Teigsmark and Øynes 1982), and the headline was between 4 and 5 m above the bottom.

All fish species taken as by-catch were counted, and commercial important species as cod, haddock, Greenland halibut, redfish etc. were measured by length.

Alltogether 23 strata were worked during the Barents Sea survey (Fig. 1) and 23 strata during the Spitsbergen survey (Fig. 3). In the Barents Sea each stratum was divided into rectangles of 5x5 nautical miles as described by Teigsmark and Øynes (1981). In the Spitsbergen area the same strata system were used as in the bottom trawl survey for cod (Godø and Nedreaas 1986). All trawl stations were randomly allocated to rectangles.

Hydrographical observations were made at each trawl station with a CTD-sonde.

The total and commercial biomass of shrimps in each stratum and

all strata summarized have been calculated for all years according to Teigsmark and Øynes (1982). The commercial stock, i.a. that part of the stock available to the commercial fleet using 35 mm mesh size was calculated as in Teigsmark and Øynes (1981).

### The Barents Sea

Fig. 2 shows the area covered by the 1986 survey. Altogether 146 stations were taken (Table 1). Strata 1-15 were worked according to the same method as used by Hysten *et. al.* (1984). The same unfavourable ice condition was observed in 1986 as in 1985 (Tveranger and Øynes 1985), and strata 18, 24 and parts of 16 and 17 were not covered during the spring survey. These strata together with strata 19-21 were covered during the July/August survey, and the estimated biomass for these strata were included in the biomass for the Barents Sea. In most of the strata the same numbers of hauls as in 1985 were allocated to each stratum. In the most important strata up to 10% of the rectangles were worked.

Great areas in the Barents Sea south of  $N74^{\circ}00'$  were closed for commercial shrimp trawling in winter and spring 1986, due to large numbers of juvenile cod and haddock in shrimp trawl catches. Therefore, a large fishing fleet was trawling in strata 15, 16 and 18 during the survey in May. In the rest of the survey area there had been only minor trawling until May.

### The Spitsbergen area

The survey in 1986 covered 90 stations in the area from "Kveithola" (stratum 1) and northwards along the western slope off Spitsbergen to  $N80^{\circ}30'$  and also north of Spitsbergen in stratum 23 (Fig. 4).

### SHRIMP STOCK BIOMASS

In the 1985 surveys the bottom temperatures were above zero in the

whole survey area in the Barents Sea. During the 1986 survey the Tiddly Bank area (stratum 7), the Thor Iversen Bank area (strata 11 and 12) and a part of strata 6 and 10 were overflowed by cold bottom water with temperatures between  $-1^{\circ}\text{C}$  and  $-1,3^{\circ}\text{C}$ . The cold layer was 25-35 m thick. The temperature increased westward and south toward the Finnmark coast.

The area southeast of Hopen Island (strata 16 and 18) was the main fishing ground for the commercial fleet during early 1986. At the end of June the fishing fleet had to leave this area because the by-catch of polar cod increased to a high level.

During the survey in April/May this area was covered with drift ice which made it difficult to carry out the investigations, and the northern part of strata 16 and 17 had to be postponed to the July - August survey. In the last part of July the Hopen Island area (strata 16, 17, 18 and 24) was overflowed by cold bottom water, like the situation in the spring at Tiddly and Thor Iversen Bank. This cold bottom water layer, 25-35 m thick, covered most of the strata 16 and 17, and the whole strata 18 and 24.

The bottom temperatures in the Spitsbergen area is characterized by sharp gradients along the western slope off Vest-Spitsbergen. Within a few nautical miles from east to west, the temperature may change  $2-3^{\circ}\text{C}$ . The bottom temperatures in the survey area were above  $0^{\circ}\text{C}$  in all strata except in parts of strata 7 and 23.

#### Barents Sea stock

A decline was observed from 1985 to 1986 in total and commercial biomass in all strata in the Barents Sea except for strata 8, 13, 17, 20, 22 and 24 (Tables 1 and 2). The decline was most severe in the eastern and northern part of the survey area, covering the important fishing grounds as the North Cape deep (strata 1-4), Tiddly Bank (stratum 7), Thor Iversen Bank (strata 10-12) and the southern part of the Hopen Island area (Strata 14 and 15). This

6

means that the most important fishing grounds used before 1985 now have a density of shrimps below the level of commercial interest.

An increase from 1985 to 1986 of about 7000 tonnes in stratum 24 indicates a recent recruitment in the most northern part of the survey area which is also confirmed by a high abundance of males (Table 2). An increase in biomass of about 8000 tonnes is observed in strata 20 and 22, the eastern part of the Bear Island grounds. This field contains a relatively high numbers of cod and other shrimp predators, but little commercial fishing takes place in this area.

The total biomass of shrimp is estimated to 159 000 +/- 12 000 tonnes (Tables 1 and 2), which indicates a decrease of 27,1% from 1985 to 1986. The biomass of the commercial stock is estimated to be about 130 000 tonnes giving a decrease of 30,5% from 1985 (Tables 3 and 4). This is the lowest biomass of shrimp calculated since these investigations started in 1980. However, the most dramatic change in the biomass of the shrimp stock biomass was observed from 1984 to 1985, with approximately a 50% decrease.

A decrease in the abundance of intersexes, males and females from 1985 to 1986 indicates also a negative development in the stock (Table 5). The abundance of females are expected to decrease further in 1987, caused by the low abundance of the intersexes in 1986. It is difficult to give a prognosis for the development of the abundance of males. Even if the 1983 year class was observed in 1985 as a strong year class, the abundance of males did not increase in 1986. However, this year class might have been reduced by predation and fishing later than May in 1985 and early 1986. The survey results in 1984, 1985 and 1986 indicate that the 1984 year class is smaller than the 1983 and the 1985 year class is probably not a rich one. An increase in the abundance of males is therefore not expected in 1987. Therefore, a positive development of the stock in 1987 can not be expected.

### Spitsbergen stock

The stock biomass has continued to decline from 1984 and onwards in the strata between 200 and 300 m (strata 2,4,6,7,9,11,13 and 15), but still about 40% of the total biomass at Spitsbergen is observed in these "shallow" waters (Tables 6 and 7). The stock biomass in the strata between 300 and 600 m (strata 16-22) has also decreased, except in stratum 18 where a small increase has occurred. Altogether, the total stock biomass in this depth intervall was in 1986 less than half the biomass in 1982. The total stock biomass of shrimp is estimated to 22 000 +/- 3300 tonnes in 1986 (Table 6). This gives a decrease in stock biomass of about 37% from 1985 (Table 7). The commercial stock biomass in 1986 is estimated to about 18000 +/- 2500 tonnes (table 8), giving a decrease of about 40%.

The decline in biomass is caused by at least two factors. The shrimp stock in the Spitsbergen area was heavily fished in the years from 1984 to 1986 and the abundance of cod has increased in almost all strata from 1984 (Hysten *et. al.* 1984). This has lead to an increased natural mortality caused by a higher predation pressure on the stock.

A decrease of the abundance of males, intersexes and females is observed from 1985 to 1986 (Table 9). The abundance of females is expected to decrease further in 1987, caused by the low abundance of intersexes in 1986. No prognosis of the development of the other sexes can be given. However, all together the decreasing trend in the abundance of the sexes and the stock biomass caused by increasing exploitation and predation by cod justify to indicate a further negative development of the state of the shrimp stock in 1987.

## BY-CATCHES OF FISH

Barents Sea

In 1986 a high abundance of cod and haddock was observed in the important shrimp areas (Hysten et. al. 1986). In order to limit the by-catches of juvenile cod and haddock, important fishing grounds for the shrimp fishing fleet were closed for trawling during the winter 1985-1986 and the spring and summer 1986. During the 1986 shrimp survey cod was present in all strata except stratum 24 (Table 10). Few cod were present in the areas southeast of Hopen (strata 16-18), probably caused by cold bottom water. In all strata east of Thor Iversen Bank (strata 8-15) cod was about four times more numerous in the 1986 survey than in 1985. In previous years cod was seldom observed deeper than 300 m in the Barents Sea. However, high abundance of cod was observed in 1986 down to 500 m (Strata 8,9 and 13). All areas near the coast of Finnmark (strata 1-4) and the areas south of Bear Island (strata 19-22) had approximately the same abundance of cod in 1986 as in 1985.

In the years 1981 to 1983 only few cod was present in most of the survey area. The abundance increased in 1984 and 1985 by more than ten times, mostly caused by the 1982 and 1983 yearclasses. For the total survey the abundance of cod were at the same level in 1986 as in 1985.

The abundance of haddock was smaller in 1986 than the years before, and only one haul (stratum 5) had more than 300 specimens pr. hour trawling. Only few specimens were caught in strata 13-24 (Table 10).

The overall abundance of redfish was at the same level in 1986 as in 1985. The highest abundance was found in the deepest strata (8, 13, 14, 15, 20 and 22).

Few Greenland halibut were taken as by-catch in the Barents Sea survey in 1986. In stratum 17 (west of Central Bank) more than 100 juveniles were caught pr. hour trawling.

Compared with previous years very few capelin was found in the Barents Sea survey. Close to 300 specimens pr. hours trawling were observed only in stratum 15.

Polar cod was abundant in the strata which contained cold bottom water as Thor Iversen Bank and the area south east of Hopen Island. In stratum 18 it was near 10 000 specimens pr. hour trawling. With such a high by-catch, sorting out the shrimps is time-consuming and the fishermen cannot make a profitable fishery.

#### Spitsbergen

Cod was present in all the survey strata, except in stratum 20 (Table 11). The overall abundance of cod was at the same level in 1986 as in 1985. In 1985 the cod was most numerous in strata between 200 and 300 m. However, in 1986 the cod was spread more over the whole area and also in deeper water. The cod was mostly of commercial size except for the stratum 11 (Isfjord and Kongsfjord) where some small cod was observed.

Compared with 1985 the haddock showed a reduced abundance in 1986 in all strata. Hauls with 10-13 specimens pr. hour trawling were observed in strata 2,4 and 9. In the rest of the survey area only few specimens of haddock were caught.

Also the redfish (Sebastes mentella) showed a reduced abundance in 1986 compared with 1985. The highest abundance was found north of Isfjord.

Compared with 1984 and 1985 the Greenland halibut showed a reduced abundance in 1986 in the whole survey area.



Few capelin was found off Spitsbergen in 1986. No trawl hauls contained more than 400 individuals.

The polar cod were numerous in strata 6,7,8 and 23, i.e. the strata which were covered by the coldest water. The numbers of polar cod pr haul were ranging in the northern part of Storfjord (stratum 6 and 7) from 5000 to 10 000 specimens. Such a high by-catch made commercial shrimp fishing unprofitable.

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Table 1. Estimated density ( $\bar{C}_k$ ) and biomass in each stratum and estimated biomass in all strata summarized with the precision of the estimates. (Barents Sea).

Stratum	Area nm <sup>2</sup>	Number of hauls	$\bar{C}_k$ tons/nm <sup>2</sup>	$S_k^2$	$V(\bar{C}_k)$	Coeff. of var. (S.E./ $\bar{C}_k$ )	Biomass tons	S.E. of biomass
1	1200.	4.	0.884	0.248	0.062	0.281	1061.	298.522
2	1650.	3.	0.369	0.145	0.048	0.595	609.	362.459
3	1950.	5.	1.710	0.062	0.012	0.065	3334.	217.288
4	2300.	7.	2.043	1.397	0.200	0.219	4698.	1027.598
5	2400.	4.	0.791	0.317	0.079	0.356	1899.	676.032
6	2700.	9.	1.114	0.684	0.076	0.248	3008.	744.597
7	1850.	6.	2.093	0.442	0.074	0.130	3872.	501.964
8	2400.	5.	1.520	0.546	0.109	0.218	3647.	793.249
9	1500.	4.	1.016	0.233	0.058	0.237	1524.	361.789
10	1500.	6.	2.884	7.102	1.184	0.377	4327.	1631.963
11	1325.	4.	1.148	0.992	0.248	0.434	1521.	659.777
12	1375.	7.	5.013	19.803	2.829	0.336	6892.	2312.726
13	2700.	4.	6.569	22.252	5.563	0.359	17736.	6368.286
14	2550.	8.	4.386	21.327	2.666	0.372	11184.	4163.467
15	2025.	6.	5.567	9.564	1.594	0.227	11272.	2556.691
16	1575.	5.	3.852	1.023	0.205	0.117	6066.	712.456
17	1525.	6.	10.957	49.160	8.193	0.261	16710.	4365.180
18	2500.	8.	4.472	12.459	1.557	0.279	11179.	3119.915
19	1325.	2.	0.448	0.235	0.118	0.765	594.	454.426
20	1525.	3.	8.231	2.751	0.917	0.116	12552.	1460.231
21	3300.	6.	1.741	1.948	0.325	0.327	5746.	1880.170
22	3125.	8.	4.643	3.579	0.447	0.144	14510.	2090.080
24	1625.	6.	9.058	68.987	11.498	0.374	14719.	5510.120

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158661.

12088.037

Table 2. Estimated biomass of shrimp in each stratum in the Barents Sea in the years 1981 to 1986 in 1000 tons.

Stratum	Year					
	1981	1982	1983	1984	1985	1986
1	8.5	8.3	6.0	5.3	4.1	1.1
2	6.7	5.2	4.8	3.6		0.6
3	11.4	7.4	14.7	13.9	11.3	3.3
4	14.0	13.9	14.8	17.5	7.9	4.7
5	3.2	5.2	8.1	1.9	3.0	1.9
6	16.7	26.0	38.9	18.8	4.7	3.0
7	11.9	7.6	18.0	32.4	12.4	3.9
8	10.9	19.2	10.6	8.4	3.5	3.7
9	12.8	15.7	13.0	20.2	3.6	1.5
10	14.9	14.9	21.4	16.5	7.0	4.3
11	12.9	11.8	16.2	23.2	1.8	1.5
12	17.3	16.8	22.9	23.9	18.6	6.9
13	19.9	13.3	20.9	29.1	7.7	17.7
14	21.0	21.1	39.4	34.6	29.4	11.2
15	21.9	22.4	31.4	40.8	17.2	11.3
16		7.2	16.0	36.8	15.6	6.1
17		9.3	16.9	21.0	9.2	16.7
18		5.9	8.0	7.5	24.6	11.2
19	3.8	1.6		5.1	0.7	0.6
20	14.8	13.0	16.0	15.4	6.5	12.6
21	10.4	14.5	8.0	16.8	9.0	5.7
22	17.7	24.4	22.2	22.0	13.8	14.5
23				4.9		
24					6.7	14.7
	250.8	284.6	368.2	419.6	218.2	158.6

Table 3. Estimated commercial density ( $\bar{C}_k$ ) and biomass in each stratum and estimated commercial biomass in all strata summarized with the precision of the estimates. (Barents Sea).

Stratum	Area nm <sup>2</sup>	Number of hauls	$\bar{C}_k$ Tons/nm <sup>2</sup>	$S_k^2$	$V(\bar{C}_k)$	Coeff. of var. (S.E./ $\bar{C}_k$ )	Biomass tons	S.E. of biomass
1	1200.	4.	0.792					
2	1650.	3.	0.271	0.203	0.051	0.285	951.	270.614
3	1950.	5.	1.425	0.085	0.028	0.620	448.	277.905
4	2300.	7.	1.646	0.072	0.014	0.084	2780.	233.676
5	2400.	4.	0.589	0.840	0.120	0.210	3786.	796.956
6	2700.	9.	0.875	0.178	0.045	0.358	1413.	506.694
7	1850.	6.	1.748	0.450	0.050	0.256	2364.	604.015
8	2400.	5.	1.112	0.306	0.051	0.129	3233.	417.986
9	1500.	4.	0.774	0.305	0.061	0.222	2670.	592.988
10	1500.	6.	2.333	0.108	0.027	0.212	1161.	246.045
11	1325.	4.	0.966	4.621	0.770	0.376	3500.	1316.449
12	1375.	7.	4.212	0.692	0.173	0.430	1280.	550.948
13	2700.	4.	5.521	13.998	2.000	0.336	5792.	1944.376
14	2550.	8.	3.856	14.685	3.671	0.347	14908.	5173.391
15	2025.	6.	4.926	16.806	2.101	0.376	9834.	3695.951
16	1575.	5.	3.198	8.137	1.356	0.236	9976.	2358.161
17	1525.	6.	8.828	1.170	0.234	0.151	5037.	762.009
18	2500.	8.	3.388	36.443	6.074	0.279	13462.	3758.365
19	1325.	2.	0.377	8.154	1.019	0.298	8471.	2523.953
20	1525.	3.	6.809	0.172	0.086	0.779	499.	388.841
21	3300.	6.	1.487	1.371	0.457	0.099	10384.	1031.016
22	3125.	8.	3.847	1.423	0.237	0.327	4908.	1606.998
24	1625.	6.	6.845	2.659	0.332	0.150	12022.	1801.599
				41.380	6.897	0.384	11123.	4267.475

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Table 4. Estimated commercial biomass of shrimps in each stratum in the Barents Sea in the years 1980 to 1986 in 1000 tons.

Stratum	Year						
	1980	1981	1982	1983	1984	1985	1986
1		7.4	7.2	5.6	4.8	3.5	1.0
2		5.1	4.2	4.1	2.6		0.4
3	4.9	9.3	6.1	13.0	12.1	10.0	2.8
4	14.7	11.5	11.5	12.7	15.2	6.6	3.8
5		2.7	4.2	6.5	1.7	2.2	1.4
6	16.6	14.2	22.0	33.7	16.5	3.6	2.4
7	3.2	9.5	6.0	15.8	28.3	11.1	3.2
8		9.4	15.5	8.8	7.4	2.8	2.7
9		10.6	13.1	11.8	18.1	3.2	1.2
10		12.2	12.6	19.4	14.9	5.9	3.5
11		10.1	29.3	14.0	21.6	1.4	1.3
12		13.9	13.7	20.7	21.3	16.4	5.8
13		16.7	11.2	19.2	25.2	6.8	14.9
14		17.6	18.8	36.2	31.1	26.4	9.8
15		18.9	19.9	30.3	37.4	15.4	10.0
16			5.8	14.5	32.9	13.9	5.0
17			7.1	14.5	17.1	8.1	13.5
18			4.4	7.1	4.6	18.8	8.5
19		3.3	1.4		4.7	0.6	0.5
20		12.6	10.9	14.1	13.8	5.6	10.4
21		9.2	12.5	7.2	15.4	7.8	4.9
22		15.3	20.2	19.5	19.6	11.8	12.0
23					4.5		
24						5.0	11.1
		209.2	237.4	328.7	371.1	186.8	130.0

Table 5. Estimated total number of and percent males, intersexes and females in the Barents Sea in the years 1981 to 1986 (numbers in millions).

Sex	Year											
	1981	%	1982	%	1983	%	1984	%	1985	%	1986	%
males	45424.3	76.6	49192.4	73.5	41864.6	59.8	50694.6	60.4	31624.8	66.2	29468.4	75.5
intersexes	7191.7	12.1	8890.2	13.3	7846.6	11.2	4676.0	5.6	4870.0	10.2	3173.5	8.1
females	6672.1	11.3	8807.0	13.2	20267.9	29.0	28499.7	34.0	11269.4	23.6	6391.9	16.4
total	59288.2	100.0	66889.6	100.0	69979.1	100.0	83870.3	100.0	47764.2	100.0	39033.8	100.0

Table 6. Estimated density ( $\bar{c}_k$ ) and biomass in each stratum and estimated biomass in all strata summarized with the precision of the estimates. (Spitsbergen area).

Stratum	Area nm <sup>2</sup>	Number of hauls	$\bar{c}_k$ tons/nm <sup>2</sup>	$S_k^2$	$V(\bar{c}_k)$	Coeff. of var. (S.E./ $\bar{c}_k$ )	Biomass tons	S.E. of biomass
1	284.	3.	1.882	5.107	1.702	0.693		
2	842.	3.	0.281	0.157	0.052	0.813	534.	370.275
3	1189.	5.	3.451	5.043	1.009	0.291	237.	192.608
4	486.	3.	0.510	0.201	0.067	0.500	4103.	1193.959
5	611.	3.	2.163	7.776	2.592	0.744	248.	125.864
6	353.	3.	6.701	126.360	42.120	0.969	1321.	983.349
7	1530.	5.	1.214	1.874	0.375	0.504	2367.	2292.263
8	109.	3.	6.912	84.224	28.075	0.767	1856.	936.280
9	539.	6.	2.867	16.897	2.816	0.585	752.	576.483
10	201.	4.	2.572	2.536	0.634	0.310	1547.	905.368
11	815.	13.	5.053	13.678	1.052	0.203	516.	159.805
12	155.	3.	1.952	1.161	0.387	0.319	4119.	836.182
13	89.	3.	1.266	1.679	0.560	0.591	303.	96.421
14	56.	2.	1.820	0.035	0.017	0.072	113.	66.876
15	95.	2.	0.844	0.006	0.003	0.062	103.	7.453
16	200.	2.	0.580	0.200	0.100	0.545	80.	5.028
17	357.	2.	0.660	0.313	0.157	0.600	116.	63.316
18	246.	3.	3.693	3.761	1.254	0.303	235.	141.274
20	269.	2.	1.161	0.356	0.178	0.364	909.	275.446
21	570.	8.	1.167	1.383	0.173	0.356	312.	113.547
22	734.	5.	1.530	1.787	0.357	0.391	665.	236.979
23	125.	4.	3.654	1.144	0.286	0.146	1123.	438.846
							457.	66.848

ALL STRATA:

22017.

3312.130



Table 7. Estimated biomass of shrimps in each stratum at Vest-Spitsbergen in the years 1982 to 1986 in 1000 tons.

Stratum	Year				
	1982	1983	1984	1985	1986
1	0.1	3.2	5.3	0.3	0.5
2	1.4	0.9	0.0	0.0	0.2
3	8.2	5.0	10.6	2.0	4.1
4	4.1	14.4	0.8	0.0	0.2
5	4.4	0.2	3.4	1.7	1.3
6	0.5	0.3	0.4	5.0	2.4
7		0.6	0.2	7.0	1.9
8	1.1	2.4	3.2	0.1	0.7
9	3.4	4.8	1.1	0.3	1.5
10	4.2	1.3	1.1	2.0	0.5
11	6.4	3.8	7.7	4.3	4.1
12	2.2	2.5	0.6	0.6	0.3
13	0.8	2.0	0.1	0.0	0.1
14	2.3	0.5	0.4	0.5	0.1
15	1.5	1.7	0.5	0.1	0.1
16		1.4	2.2	0.8	0.1
17		0.3	1.9	0.5	0.2
18		0.2	0.6	0.5	0.9
19		6.0	3.8	1.0	0.0
20		1.4	1.6	1.5	0.3
21		5.5	1.7	3.0	0.7
22		0.9	5.5	4.0	1.1
23			1.2		0.5
	40.4	58.7	54.0	35.0	22.0

Table 8. Estimated commercial density ( $\bar{C}_k$ ) and biomass in each stratum and estimated commercial biomass in all strata summarized with the precision of the estimates. (Spitsbergen area).

Stratum	Area nm <sup>2</sup>	Number of hauls	$\bar{C}_k$ Tons/nm <sup>2</sup>	$S_k^2$	$V(\bar{C}_k)$	Coeff. of var. (S.E./ $\bar{C}_k$ )	Biomass tons	S.E. of biomass
1	284.	3.	1.471	3.264	1.088	0.709	417.	296.002
2	842.	3.	0.228	0.111	0.037	0.846	192.	162.223
3	1189.	5.	2.899	3.227	0.645	0.277	3447.	955.182
4	486.	3.	0.378	0.103	0.034	0.491	184.	90.174
5	611.	3.	1.813	5.160	1.720	0.723	1107.	801.094
6	353.	3.	4.757	62.781	20.927	0.962	1680.	1615.747
7	1530.	5.	0.966	1.360	0.272	0.540	1477.	797.825
8	109.	3.	5.940	58.764	19.588	0.745	646.	481.530
9	539.	6.	2.442	12.303	2.051	0.586	1317.	772.553
10	201.	4.	1.989	1.163	0.291	0.271	399.	108.198
11	815.	13.	3.949	8.145	0.627	0.200	3219.	645.249
12	155.	3.	1.859	1.059	0.353	0.320	288.	92.108
13	89.	3.	1.189	1.560	0.520	0.607	106.	64.463
14	56.	2.	1.693	0.032	0.016	0.074	96.	7.100
15	95.	2.	0.790	0.006	0.003	0.068	75.	5.117
16	200.	2.	0.472	0.137	0.068	0.553	94.	52.258
17	357.	2.	0.556	0.220	0.110	0.597	199.	118.506
18	246.	3.	3.186	2.913	0.971	0.309	784.	242.415
20	269.	2.	1.052	0.222	0.111	0.316	283.	89.562
21	570.	8.	1.087	1.153	0.144	0.349	619.	216.438
22	734.	5.	1.402	1.457	0.291	0.385	1029.	396.224
23	125.	4.	2.523	0.532	0.133	0.145	315.	45.597

ALL STRATA: 17975. 2546.038

Table 9. Estimated total number of and percent males, intersexes and females in the Spitsbergen area in the years 1981 to 1986 (numbers in millions).

Sex	Year									
	1982	%	1983	%	1984	%	1985	%	1986	%
males	5401.0	73.5	5260.9	59.9	7114.3	71.8	5765.2	76.6	4399.7	80.2
intersexes	953.0	13.0	1057.1	12.0	368.0	3.7	535.5	7.1	207.5	3.8
females	991.3	13.5	2463.7	28.1	2432.8	24.5	1223.0	16.3	881.7	16.0
total	7345.4	100.0	8781.7	100.0	9915.1	100.0	7764.2	100.0	5488.9	100.0

Table 10. Catch of shrimps and by-catch composition in the different strata in the Barents Sea in April - May and July - August 1986.

Stratum number	Number of hauls	Shrimps pr 3 n.m. (kg)	By-catch of fish in numbers pr 3 n.m. trawled							
			Cod	Haddock	Redfish	Greenl. halibut	Capelin	Polar-cod	Long rough dab	Others
1	3	14	120	41	421	2	0	0	7	29
3	6	21	118	83	306	1	1	0	16	191
4	4	40	126	11	175	9	4	0	75	31
5	1	14	155	355	40	0	0	0	50	29
6	10	22	114	17	206	3	17	0	238	67
7	6	38	62	1	52	2	15	0	405	202
8	5	27	225	70	1680	5	16	0	137	29
9	5	41	108	15	749	15	32	0	329	39
10	5	38	977	45	955	13	253	0	255	69
11	4	20	298	30	142	5	39	3000	717	94
12	8	64	137	31	287	16	15	1200	687	206
13	5	53	73	4	3951	25	36	1	182	51
14	7	93	121	0	1355	35	0	4	94	1008
15	6	104	214	2	1194	49	294	29	222	234
16	5	72	6	0	488	3	159	4769	184	261
17	6	206	19	0	604	112	101	5893	241	405
18	8	83	1	0	40	0	167	9895	130	250
19	3	5	91	5	755	6	243	14	256	23
20	5	107	53	1	4540	56	16	39	194	61
21	6	32	148	2	1186	11	14	57	164	38
22	7	89	29	0	2650	56	13	307	182	37
24	7	165	0	0	40	8	296	5816	152	185

Table 11. Catch of shrimps and by-catch composition in the different strata in the Spitsbergen area in July and August 1986.

Stratum number	Number of hauls	Shrimps pr 3 n.m. (kg)	By-catch of fish in numbers pr 3 n.m. trawled							
			Cod	Haddock	Redfish	Greenl. halibut	Capelin	Polar- cod	Long rough dab	Others
1	3	34	106	1	732	18	378	34	625	361
2	4	3	134	12	171	3	265	14	229	84
3	5	64	48	0	742	202	1	359	154	122
4	3	12	234	13	118	4	2	7	469	87
5	3	40	76	1	395	49	1	542	140	347
6	3	126	71	4	89	19	205	9286	208	792
7	6	21	311	0	12	83	85	4784	470	274
8	2	168	234	5	359	68	0	2140	161	162
9	6	53	224	10	2443	13	44	123	248	390
10	5	51	70	1	1097	48	38	793	113	2496
11	15	82	148	1	2674	55	24	566	477	1112
12	3	36	128	5	968	7	49	60	245	57
13	3	23	165	5	1946	2	330	71	40	87
14	2	33	201	4	4040	16	18	35	226	185
15	2	15	35	0	3013	0	64	18	283	115
16	3	10	213	4	1080	1	6	2	19	622
17	2	11	19	0	103	31	0	0	8	135
18	3	69	32	0	866	74	5	251	10	146
19	2	36	18	1	1139	13	3	585	4	20
20	2	21	0	0	211	43	4	521	17	33
21	6	24	11	0	89	52	2	73	47	149
22	5	50	16	0	200	113	10	500	52	190
23	4	68	2	0	97	27	7	3422	269	654

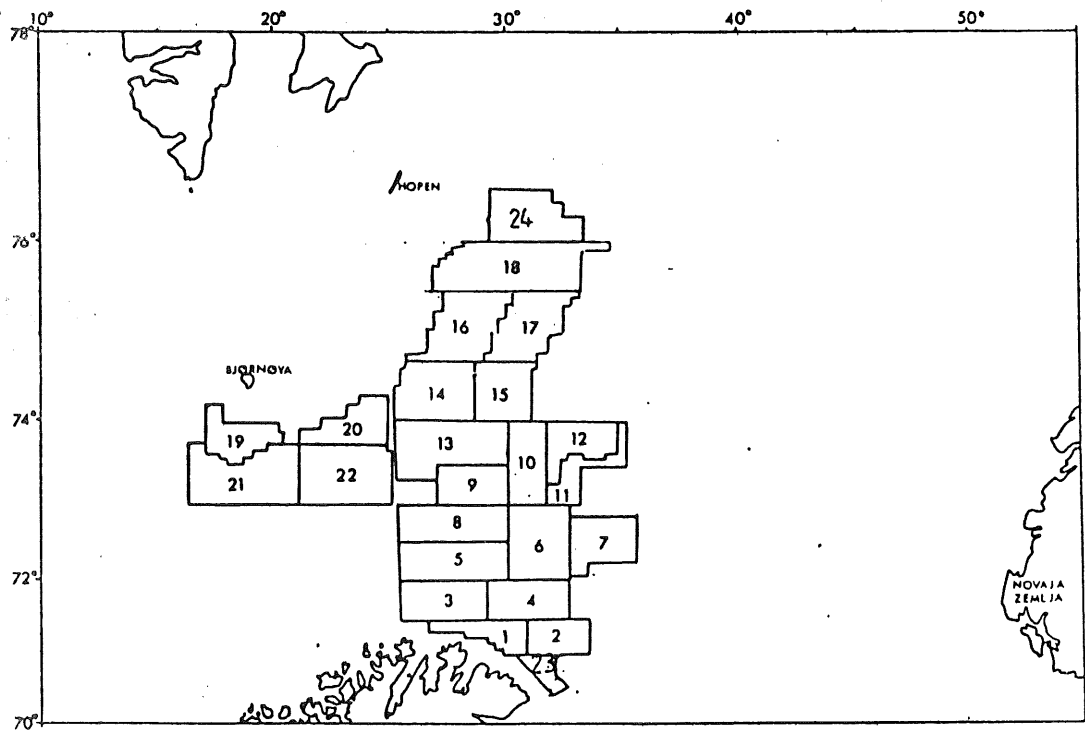


Fig. 1. Sampling strata used in May and July-August 1986 in the Barents Sea for the shrimp survey with R/V "Michael Sars".

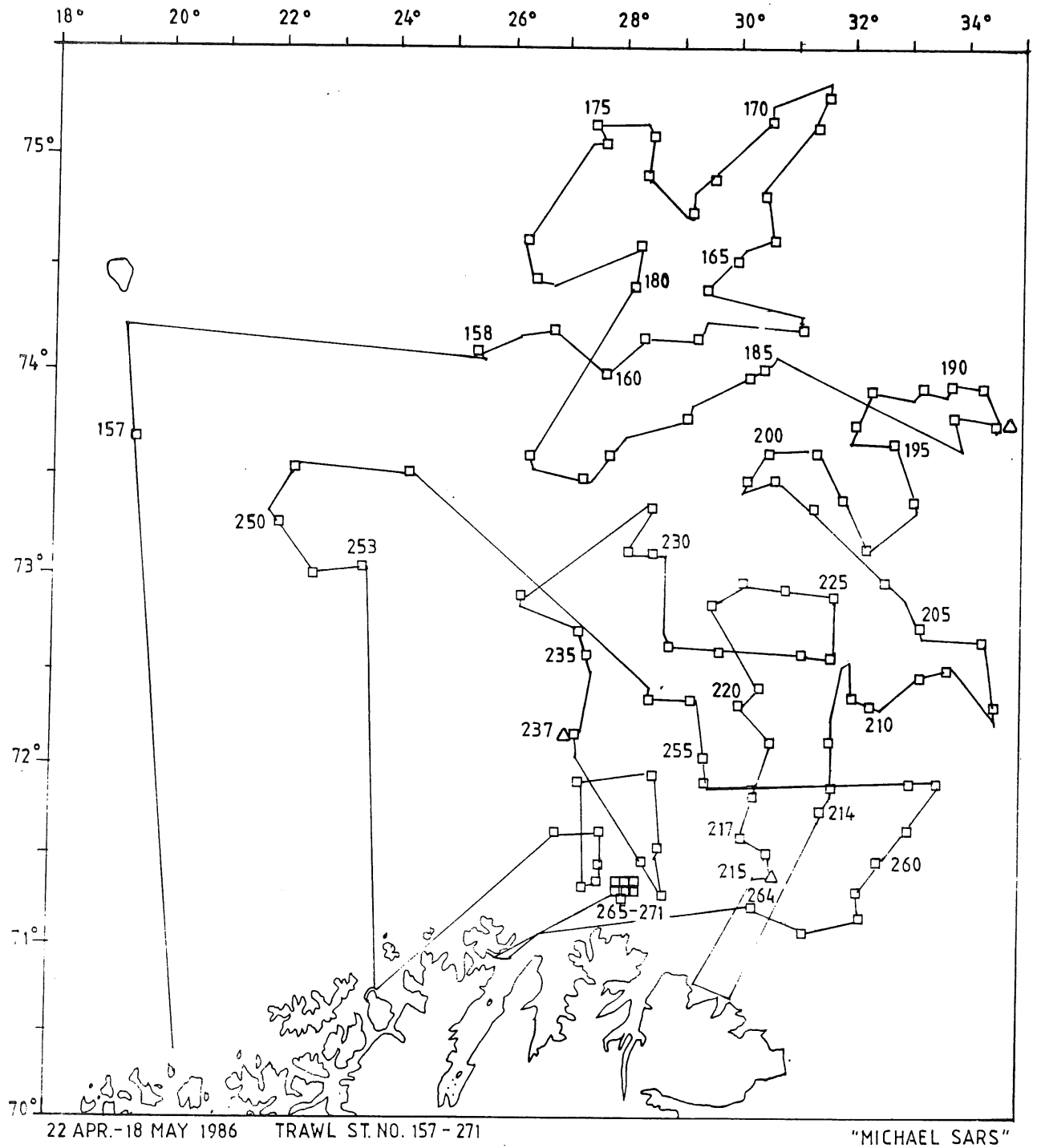


Fig. 2. Survey tracks and trawlstations taken by R/V "Michael Sars" in Barents Sea in April - May.

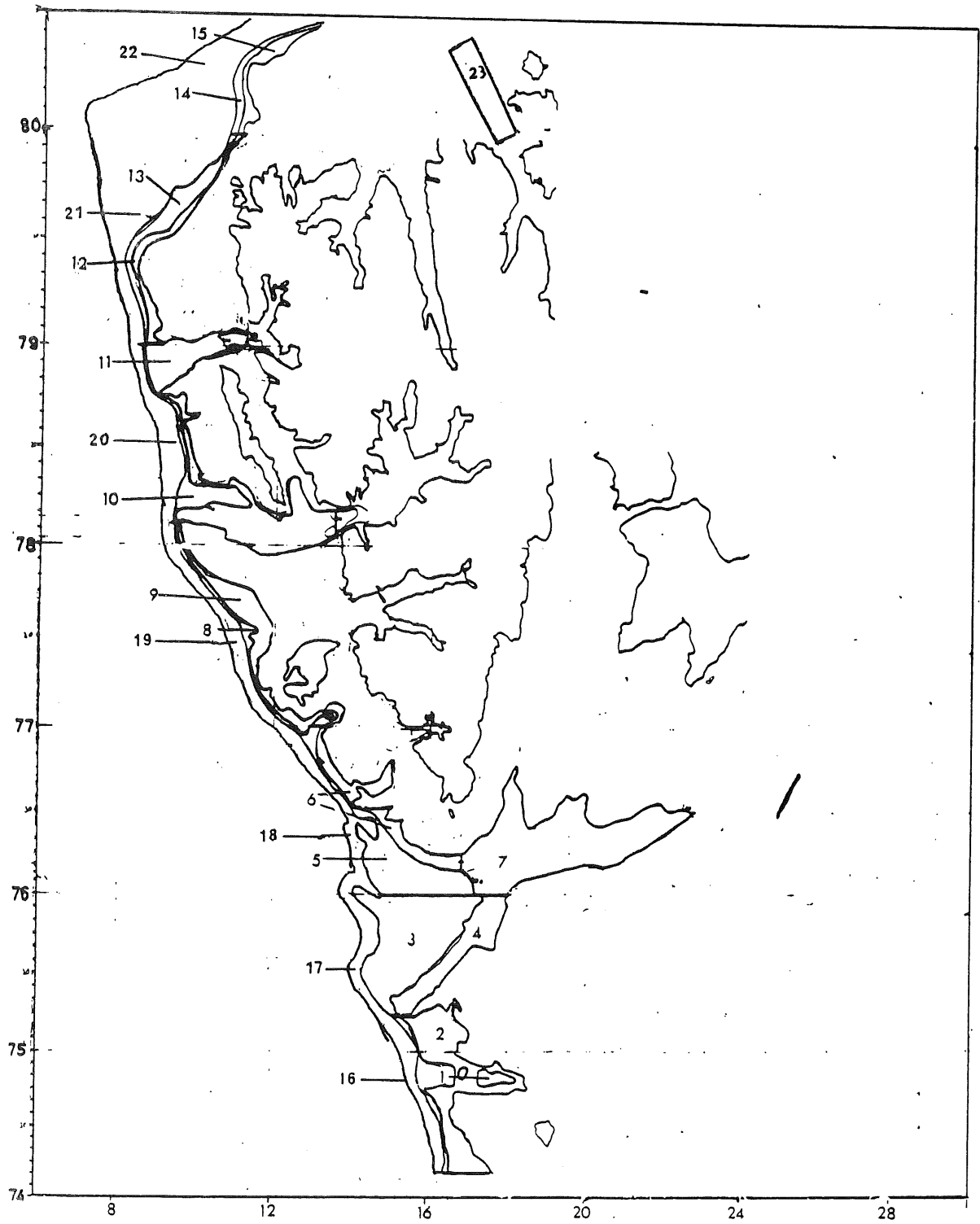


Fig. 3. Sampling strata used in July - August 1986 in the Spitsbergen area for the shrimp survey with R/V "Michael Sars"



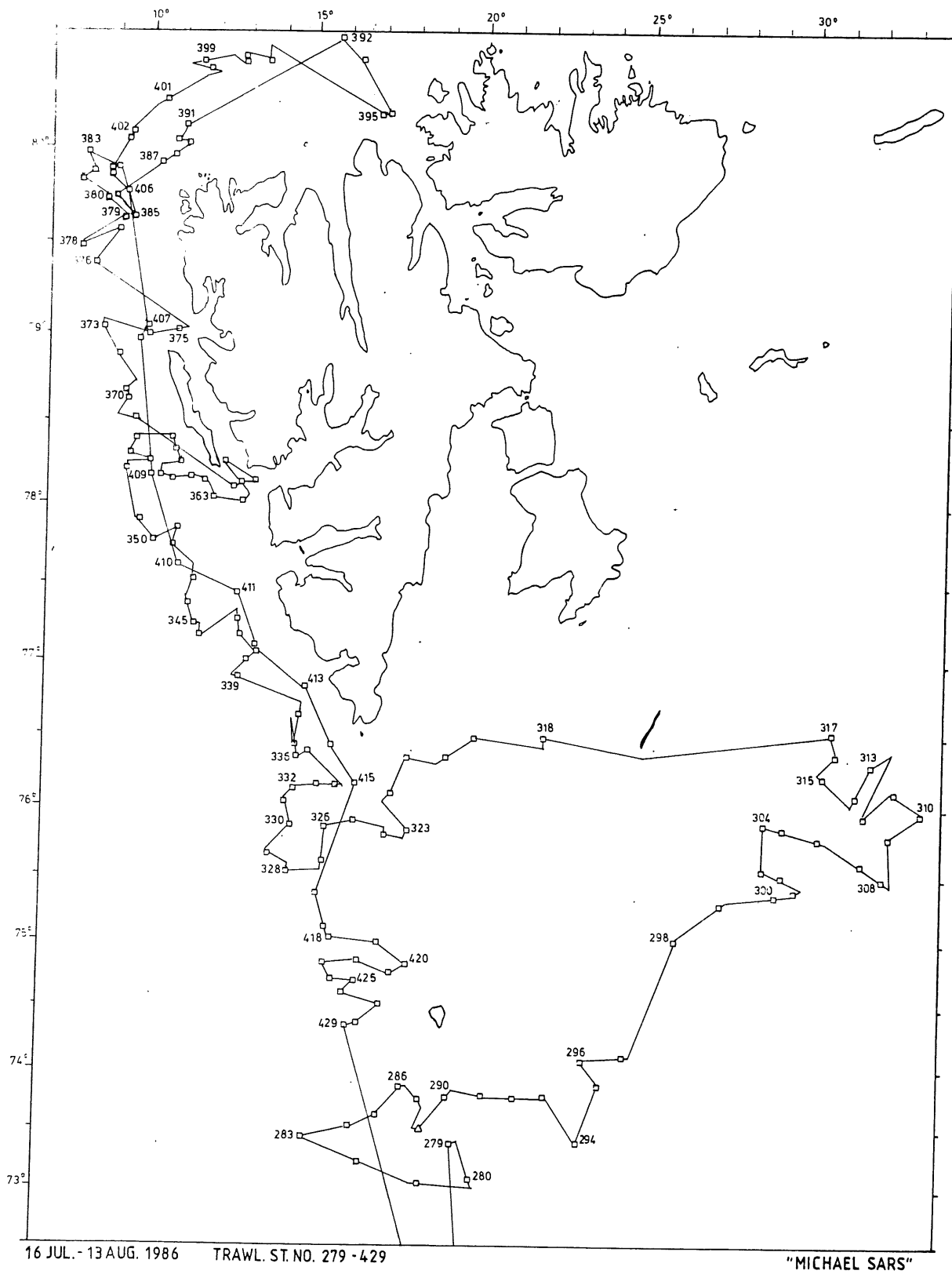


Fig. 4. Survey tracks and trawlstations taken by R/V "Michael Sars" in the Barents Sea and in the Spitsbergen area in July - August 1986.

