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Shellfish Committee

RESULTS OF NORWEGIAN AND RUSSIAN INVESTIGATIONS OF SHRIMP (*Pandalus borealis*) IN THE BARENTS SEA AND THE SVALBARD AREA 1994

by

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ABSTRACT

The results of the Russian and Norwegian surveys for shrimp, *Pandalus borealis*, in the Barents sea and the Svalbard area in 1994 are discussed in this paper. Shrimp biomass estimates are presented since 1982. The survey results are estimated by nation but the discussion is given combined. Biomass, abundance and sex frequency are given for sub areas. Data from the Russian economical zone are presented.

The data from both countries show similar trends. In the Barents sea and in the Svalbard area Norwegian and Russian data show a decrease of approximately 50 % since 1991 when there was a peak in the shrimp stock. The decrease since 1993 is highest in the Goose Bank, Tiddly Bank, Thor Iversen Bank and in the Hopen area in the Barents sea. A slight increase is observed in the westernmost area around the Bear Island. The general reduction in biomass is explained by cod predation during the last tree years. Probably temperature reduction in the northern and eastern Barents Sea causes a local but heavy decrease from 1993.

INTRODUCTION

Annual shrimp surveys has been undertaken in the Barents sea and in the Svalbard area by Norway since 1982 and by Russia since 1984. However, the first joint report was published in 1992 (Berenboim *et al.* 1992). The Russian and Norwegian investigations will be expanded to the eastern part of the Barents sea in 1994. Thereby the Russian economical zone (REZ) will be included into the joint work and the Russian data from this area is included in this report. The co-operation in evaluating the *Pandalus borealis* stock in the North East Atlantic is very important for establishment of multispecies models for fisheries regulation.

## MATERIAL AND METHODS

The stratification of the Barents sea and the Svalbard area is the same since 1991 (Fig. 1. and 2.). The stratification of the Goose Bank and the Kola coast area is shown in Fig. 3. and 4.

The Norwegian sampling trawl used is the standard sampling trawl to all bottom trawl surveys. It is a modified shrimp trawl with "rockhopper" ground gear. The "sweep width" is set to 11.7 m for shrimp surveys resulting in a swept area of a 3 nm haul of 0.01895 sq.nm. The trawling was conducted by a speed of three knots for 20 minutes.

The Russian trawl used is the standard trawl of all Russian surveys for shrimp. The "sweep width" is set to 15.5 m and the coefficient of trawl efficiency is set to 0.182 resulting in a swept area of a 3 nm haul of 0.00457 sq.nm. The trawling was conducted with a speed of 3 knots for one hour. Thus, the indices of biomass and abundance given by the two countries are comparable only by trend.

The Russian survey was conducted in the Barents Sea and in the Svalbard area from the 28th of April to the 13th of June by the R/V "Kapitan Rogozin". The Norwegian survey was conducted in the Barents Sea from the 25th of April to the 16th of May and in the Svalbard area from the 23rd of May to the 13th of June. The Norwegian surveys were conducted by the R/V "Jan Mayen". The trawl stations and the survey tracks are given in Fig. 5 to 7. The methods of conducting the survey and making the calculations are described by Teigsmark and Øynes (1982) and Berenboim *et al* (1987).

During a summary meeting in Tromsø in June 1992 it was agreed upon common methods for sex determination on shrimp (Aschan *et al.* 1993). This makes the results on sex distribution within size groups comparable.

## RESULTS AND DISCUSSION

The Russian survey in the Barents sea covered 14 strata with 45 stations and 7 strata in the REZ with 24 stations (Table 1. and 2.). The Norwegian survey covered 22 strata in the Barents sea with 88 stations (Table 3.) in addition 10 samples were taken in the REZ in the Goose Bank area. In the Svalbard area 24 strata deeper than 200m were covered by 158 stations (Table 5.). In the Svalbard area the Russian sampling took place only west of Bear Island due to ice (Table 4). The tables give the estimated biomass and abundance with standard errors for each strata.

Strata are combined into larger areas reflecting main fishing grounds Fig. 8. Biomass indices for shrimp are presented by main areas in tables 6 and 7. Russian scientists assume a catch coefficient of 0.182 that means that the survey biomass is multiplied with 5.49 before the estimate is given. The Norwegian estimate is the survey biomass and correction coefficient is not used. The Norwegian sampling trawl (Campelen 1800) is more efficient than the Russian commercial trawl. This means that the numbers presented are not directly comparable and that one has to look at the change from year to year. Note that the Russian survey does not include the eastern Bear Island Trench (area D), Bear Island (area F) and only parts of the Storfjord Trench area (G).

The biomass estimate in 1994 is compared with the numbers of 1993 and 1991 when the shrimp biomass started to decrease. The estimates in 1992 are low partly due to technical problems while sampling. In table 7. the numbers are missing in many areas over time. This is because the Russian cruise did not manage to reach the area. The size of the area is the same from year to year. In the Sptisbergen area stations sighted deeper than 200m are included in the table 6.

Since 1991 there has been a heavy reduction in the shrimp stock in the Barents Sea. Norwegian data show a reduction of 52 % in the Barents Sea ( area A, B, C, and E) whereas Russian data indicate a reduction of 58 %.

The data from both countries show similar trends. In the Barents Sea and in the Svalbard area Norwegian and Russian data show a decrease of approximately 50 % since 1991 when there was a peak in the shrimp stock. The decrease since 1993 is highest in the Goose Bank, Tiddly Bank, Thor Iversen Bank and in the Hopen area in the Barents Sea. When comparing Norwegian data from 1994 with Russian data from 1993 the reduction is over 70 % at Goose Bank. In the Tiddly Bank and the Thor Iversen Bank area the reduction is almost 60%. A slight increase is observed in the westernmost area around the Bear Island.

The general reduction in biomass is explained by cod predation during the last tree years. The increase in the cod stock in combination with a crash in the capelin stock at the same time as the herring stock still is small, results in a heavy predation pressure on the shrimp (Nielsen & Hopkins 1992). Probably temperature reduction in the northern and eastern Barents Sea causes a local but heavy decrease from 1993.

The shrimp biomass in the Svalbard area ( areas F, G and H) show a reduction from 1991 to 1994.. The reduction in the period 1993 to 1994 is concentrated to the northern areas Storfjord Trench (G) and Spitsbergen (H), while Norwegian and Russian data show an increase in the area around the Bear Island (F). This increase may be due to a concentration of shrimp into this area with relatively high water temperatures.

In the Barents Sea and in the Svalbard area in total there is a reduction in the shrimp stock of approximately 40 % since 1993. Simultaneously the shrimp is more evenly spread in the whole study area, which causes problems for the shrimp fleet. We do not believe that there will be any obvious increase in the shrimp stock next year as the cod stock still is large. Though there has been a reduction of approximately 50 % since 1991 the stock has not reached the lowest biomass estimate observed in the period 1986 - 1988.

In table 8. the sex composition for each area is presented. The results show that the definition of intersex differs between the two countries. The proportion of male has decreased since 1993 in all areas according to Russian data while Norwegian data shows this trend only in the Hopen and the Bear Island Trench areas. Some further work has to be done to ensure that the sex determination is the same on board the Norwegian and the Russian vessel.

## REFERENCES

- Aschan, M., B. Berenboim, S. Mukhin and K. Sunnanå. 1993. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis*) in the Barents Sea and Svalbard area in 1992. ICES C.M. 1993/K:9.
- Berenboim, B.I., S. Muchin, G. Shevaleva. 1987. USSR investigations of shrimp (*Pandalus borealis*) in the Barents Sea and in the Spitsbergen area in 1986. ICES C.M. 1987/K:28.
- Berenboim, B., S. Muchin and K. Sunnanå. 1992. Results of Norwegian and Russian investigations of shrimp (*Pandalus borealis*) in the Barents Sea and Svalbard area 1991. ICES C.M. 1991/K:14.
- Nilssen, E. & C. Hopkins 1992. Regional variability in fish-prawn communities and catches in the Barents sea, and in their relationship to the environment. Symposium on Hydrobiological Variability in the ICES area, Åland, Islands, 5-7 June 1991. ICES Mar. Sci. Symp. 195:331-348.
- Teigsmark, G. and P. Øynes. 1982. Norwegian investigations on the deep sea shrimp (*Pandalus borealis*) in the Barents Sea in 1982. ICES C.M. 1982/K:12.

Table 1. Results of the Russian survey in the Barents sea in May 1994.  
Area of strata, number of stations and calculation of results for each strata covered.

Stratum	Area sq.nm	Number of hauls	Mean catch kg/3nm	Biomass thousand tonnes	SE of biomass	Abun- dance billion ind.	SE of abun- dance
1s	2017	3	11.0	4.9	3.1	0.8	0.5
2	1650	3	1.0	0.4	0.4	0.1	0.1
4	2300	3	8.3	3.4	8.1	0.6	0.4
6	2700	4	29.5	17.9	4.8	3.7	1.2
7	2850	3	29.3	12.5	2.7	2.5	0.4
10	1500	3	62.7	21.3	3.2	4.1	0.4
11	1325	3	24.0	7.2	1.6	1.6	0.4
12	1375	3	64.3	20.0	10.5	4.9	2.8
14	2550	3	65.0	36.1	1.6	8.2	0.4
15	2025	2	55.5	24.8	14.1	5.4	3.2
16	1575	3	109.7	37.3	1.8	9.5	1.2
17	1525	3	151.7	50.9	10.4	12.0	2.5
18	2500	6	130.3	70.1	8.5	17.5	2.4
24	1558	3	103.3	35.2	4.3	10.2	0.4
Total	27450	45		342.0		81.100	

Table 2. Results of the Russian survey in the Russian zone in the Barents sea in May 1994.  
Area of strata, number of stations and calculation of results for each strata covered.  
\* Norwegian data corrected according to norwegian / russian catchability efficiency of 2.8.

Stratum	Area sq.nm	Number of hauls	Mean catch kg/3nm	Biomass thousand tonnes	SE of biomass	Abun- dance billion ind.	SE of abun- dance
2s	1824	3	1.3	0.5	0.5	0.1	0.1
3s	1120	4	28.3	6.9	3.9	1.5	0.9
4s	1539	3	4.3	1.5	0.2	0.3	0.1
5s	1168	3	10.3	2.6	1.4	0.3	0.2
6s	798	2	16.0	2.8	1.3	0.6	0.3
*7s	672	4	17.3	3.0	0.5	1.3	0.3
*8s	2108	5	41.6	27.3	3.0	6.3	0.5
Total	9229	24		44.6		10.4	

Table 3. Results of the Norwegian survey in the Barents sea in April - May 1994.  
Area of strata, number of stations and calculation of results for each strata covered

Stratum	Area sq.nm.	Number of hauls	Mean catch kg/nm	Biomass thousand tonnes	SE of biomass	Abun- dance billion ind.	SE of abun- dance
1	1232	2	23.7	4.6	1.4	1.2	0.3
2	1697	2	1.8	0.5	0.2	0.1	0.1
3	1926	4	25.6	7.8	3.2	1.4	0.6
4	1841	4	21.5	6.3	1.1	1.3	0.4
5	2282	5	2.0	0.7	0.4	0.2	0.1
6	2776	8	11.1	4.9	1.0	0.9	0.3
7	1953	2	10.2	3.2	0.9	0.8	0.1
8	2401	6	6.5	2.5	1.2	0.4	0.2
9	2988	3	11.2	5.3	1.6	1.1	0.3
10	2373	5	12.9	4.8	1.8	0.9	0.4
11	1364	3	15.9	3.4	0.2	0.7	0.1
12	1423	2	19.5	4.4	0.5	0.6	0.4
13	2608	6	15.6	6.5	0.8	1.4	0.2
14	2535	5	19.3	7.7	1.4	1.7	0.4
15	2039	4	16.8	5.4	1.8	1.1	0.5
16	1553	5	28.0	6.9	2.4	1.7	0.6
17	1535	1	26.6	6.5	0.0	2.1	0.0
18	2457	4	27.0	10.5	4.3	3.4	1.2
19	1299	5	3.0	0.6	0.4	0.2	0.1
20	1509	3	41.9	10.0	1.5	2.5	0.4
21	3270	5	17.5	9.1	2.3	2.0	0.5
22	3113	4	20.6	10.1	2.8	2.4	0.6
Total	46174	88		121.7		28.1	

Table 4. Results of the Russian survey in the Svalbard area in May-June 1993.  
Area of strata, number of stations and calculation of results for each strata covered.

Stratum	Area sq.nm	Number of hauls	Mean catch kg/nm	Biomass thousand tonnes	SE of biomass	Abun- dance billion ind.	SE of abun- dance
38	1399	3	28.0	8.6	1.9	2.1	0.5
39	871	3	0.0	0.0	1.0	0.0	0.2
40	3861	3	10.0	8.5	0.0	1.8	0.0
44	1217	3	13.3	3.6	10.3	0.6	1.7
Total	6477	12		20.7		4.5	

Table 5. Results of the Norwegian survey in the Svalbard area in May - June 1994.  
Area of strata, number of stations and calculation of results for each strata covered.

Stratum	Area sq.nm.	Number of hauls	Mean catch kg/nm	Biomass thousand tonnes	SE of biomass	Abun- dance billion ind.	SE of abun- dance
33	1285	2	6.0	1.2	0.1	0.3	0.0
34	900	4	28.5	1.5	2.9	0.3	0.0
35	5260	20	14.4	25.0	1.3	2.9	0.3
38	1399	14	17.7	3.9	0.7	1.3	0.3
39	871	5	10.6	1.5	1.2	0.5	0.4
40	3861	7	1.2	0.7	0.4	0.1	0.1
43	786	7	11.6	1.4	0.8	0.3	0.2
44	1217	9	6.5	1.2	0.4	0.2	0.1
45	357	4	1.6	0.1	0.0	0.0	0.0
48	1883	5	17.6	5.2	3.2	1.2	0.7
49	611	6	2.2	0.2	0.0	0.0	0.0
50	246	5	10.4	0.4	0.1	0.8	0.6
53	525	7	17.7	1.5	0.8	0.3	0.2
54	102	3	1.1	0.0	0.0	0.0	0.0
55	249	4	1.7	0.1	0.0	0.0	0.0
58	829	12	37.2	4.9	1.2	1.4	0.4
59	208	6	8.6	0.3	0.1	0.1	0.0
60	269	6	14.9	0.6	0.2	0.1	0.1
63	89	3	20.0	0.3	0.2	0.1	0.1
64	155	4	31.4	0.8	0.6	0.3	0.3
65	846	8	6.4	0.9	0.3	0.2	0.1
68	95	2	1.3	0.0	0.0	0.0	0.0
69	56	6	36.9	0.3	0.1	0.1	0.0
70	734	9	34.3	4.0	1.2	1.0	0.4
Total	22833	158		56.0		11.6	

Table 6. Biomass Indices for shrimp from Norwegian surveys in the years 1982- 1994  
by main areas (1000 tonn).

Main area	A East Finnmark	B Tiddly Bank	C - Thor Iversen bank	D - Bear Isl.Trench east	E Hopen	F Bear Island	G Storfjord Trench	H Spits- bergen	Total	Sum. A,B,C,E
Strata: Year	1 - 4	6 - 7	10 - 12	5, 8, 9, 13	14 - 18, 24	19 - 22/ 31 - 40	41 - 50	51 - 70		
1982	35	34	44	53	66	56	17	22	327	179
1983	40	57	61	53	112	52	21	33	429	270
1984	40	51	64	60	141	66	20	29	471	296
1985	23	17	27	18	96	31	17	17	246	163
1986	10	7	13	25	57	34	10	10	166	87
1987	29	13	18	23	31	10	9	13	146	91
1988	26	18	18	36	32	24	13	14	181	94
1989	41	17	13	17	33	53	22	20	216	104
1990	31	13	25	42	58	43	27	23	262	127
1991	22	28	22	54	120	44	21	10	321	192
1992	18	22	33	37	62	38	14	15	239	135
1993	17	19	32	29	85	20	12	19	233	153
1994	19	8	13	15	52	33	9	12	161	92
+% 92/91	-18	-21	50	-31	-48	-14	-33	50	-26	-30
+% 93/92	-6	-14	-3	-22	37	-47	-14	27	-3	13
+% 94/93	12	-58	-59	-48	-39	65	-25	-37	-31	-40
+% 94/91	-14	-71	-41	-72	-57	-25	-57	20	-50	-52

Table 7. Biomass Indices for shrimp from Russian surveys in the years 1984-1994  
by main areas (1000 tonn); Since 1990 the strata 1s is included into area B.

Main areas	A East Finnmark	B Tiddly Bank	C - Thor Iversen Bank	E Hopen	F Bear Island	G Storfjord Trench	H Splits- berger	I Kola coast	K Goose Bank	Total	Sum. A,B,C, E
Strata Year	1 - 4	6 - 7, 1s	10 - 12	14 - 18, 24	31 - 40	41 - 50	51 - 70	2s-6s	7s-8s		
1984	38	137	99	254				133		661	528
1985	14	45	74	255		6	46	19	9	468	388
1986	9	19	44	140		42	127	9	9	399	212
1987	16	17	59	107	45	36	27	25	14	346	199
1988	14	31	39	49		22	29	36	13	233	133
1989	70	128	57	132	6	60	25	105	20	603	387
1990	90	195	119	259	14	110	30	196	15	1028	663
1991	90	153	104	541	9	70	27	155	43	1192	888
1992	80	153	92	409				65	77	876	734
1993	45	91	159	382	9		58	37	111	892	677
1994	4	35	48	255	21			14	27	377	342
+% 92/91	-11	0	-12	-24				-58	79	-27	-17
+% 93/92	-44	-41	73	-7				-43	44	2	-8
+% 94/93	-91	-62	-70	-33	133			-62	-76	-58	-49
+% 94/91	-96	-77	-54	-53	133			-91	-37	-68	-61

\* At the Goose Bank the biomass in 1994 is estimated from Norwegian survey results since the area was not reached by Russian cruise.

Table 8. Sex composition in each area in 1993 and 1994.

Russian data						
SEX COMPOSITION (%) 1993						
AREA	MALE	INTERSEX	FEMALE			
			1	2	3	Total
Hopen	66.2	0.7	19.5	2.1	11.5	33.1
Thor-Iversen	66.5	2.9	17.3	9.7	3.3	30.3
East-Finnmark	56.3	3.7	21.8	5.9	12.3	40.0
Tiddly Bank	64.1	2.6	19.5	7.7	6.1	33.3
Cola coast	43.6	3.4	33.0	13.0	17.0	53.0
Goose Bank	56.8	0.7	31.3	2.0	9.2	42.5

Norwegian data						
SEX COMPOSITION (%) 1993						
AREA	MALE	INTERSEX	FEMALE			
			1	2	3	Total
Hopen	67.1	5.4	16.0	7.0	4.5	27.5
Thor-Iversen	68.5	4.1	14.6	9.0	3.8	27.4
East-Finnmark	52.2	26.3	1.0	15.4	5.1	21.5
Tiddly Bank	67.7	6.6	15.0	7.9	2.8	25.7
Bear Island	57.2	6.2	13.1	14.6	9.0	36.7
Bear Island Trench	60.1	16.7	5.5	13.5	4.2	23.3

Russian data						
SEX COMPOSITION (%) 1994						
AREA	MALE	INTERSEX	FEMALE			
			1	2	3	Total
Hopen	66.1	0.3	26.0	2.5	5.1	33.0
Thor-Iversen	63.5	1.2	18.2	3.8	13.3	35.3
East-Finnmark	47.0	1.4	24.7	0.9	26.0	51.6
Tiddly Bank	64.0	0.2	19.0	1.2	14.9	35.8
Cola coast	44.0	0.3	40.9	1.3	13.5	55.7
Goose Bank						

Norwegian data						
SEX COMPOSITION (%) 1994						
AREA	MALE	INTERSEX	FEMALE			
			1	2	3	Total
Hopen	72.1	1.2	19.8	1.3	5.6	26.7
Thor-Iversen	54.9	12.4	18.0	3.8	10.9	32.7
East-Finnmark	52.6	31.1	0.7	2.2	13.4	16.3
Tiddly Bank	63.2	11.2	16.2	3.7	5.7	25.5
Bear Island	52.8	12.1	14.8	9.9	10.2	35.0
Bear Island Trench	64.0	17.4	8.2	2.3	8.1	18.6

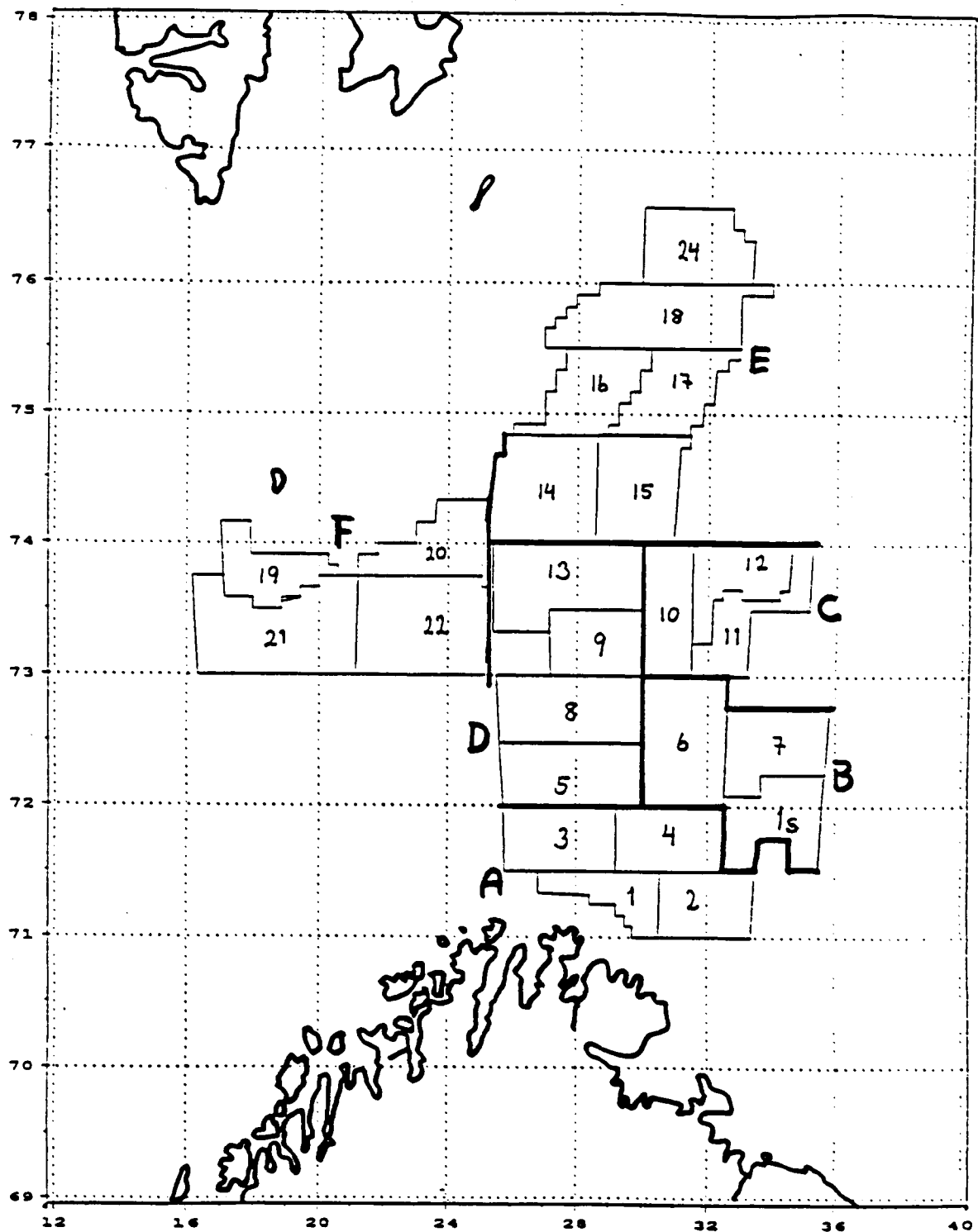


Figure 1. Sampling strata used in the Barents Sea for the shrimp surveys. Divisions into main areas are given as letters A to F.

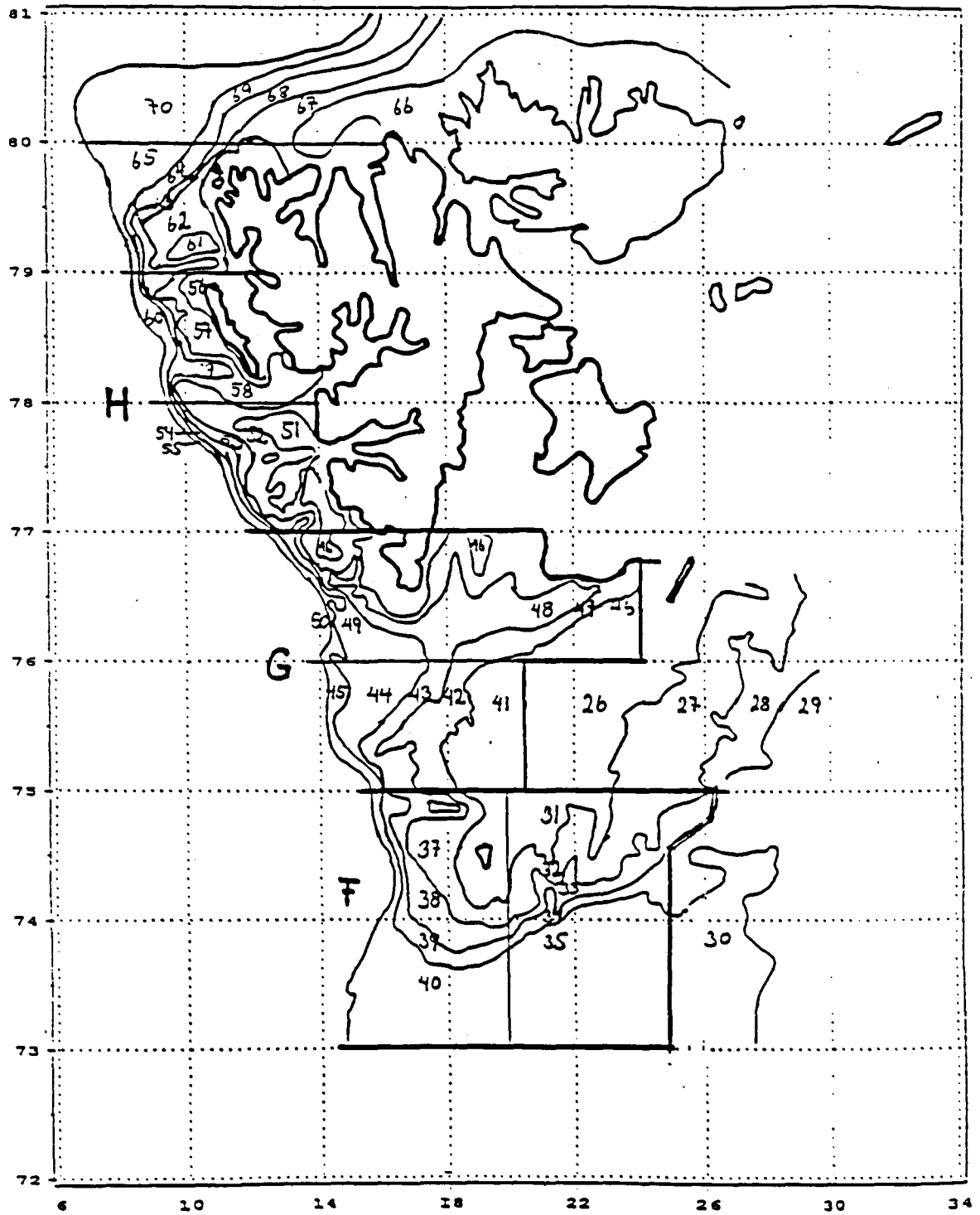


Figure 2. Sampling strata used in the Svalbard area for the shrimp surveys. Divisions into areas are given as letters F to H.

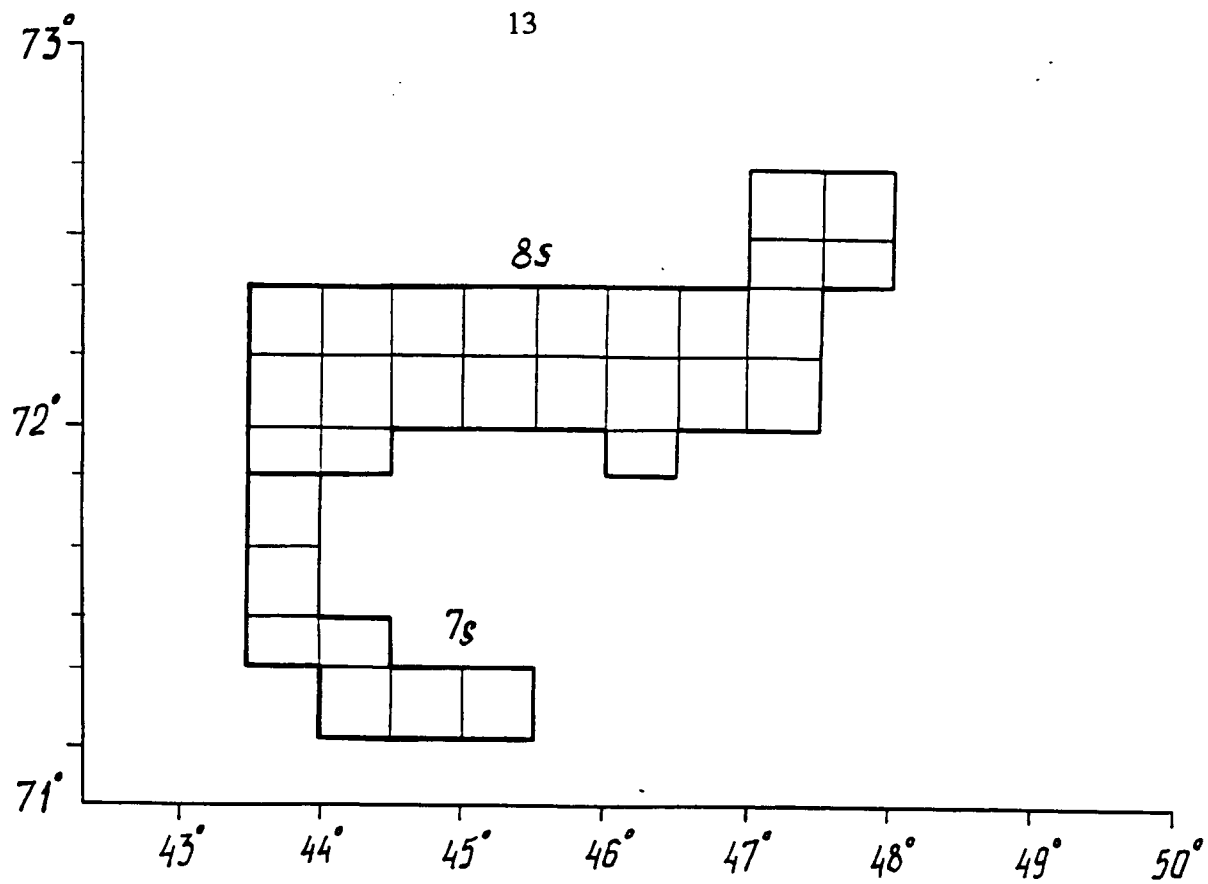


Fig. 3. Sampling strata used in the Barents Sea in the Russian zone at the Goose Bank.

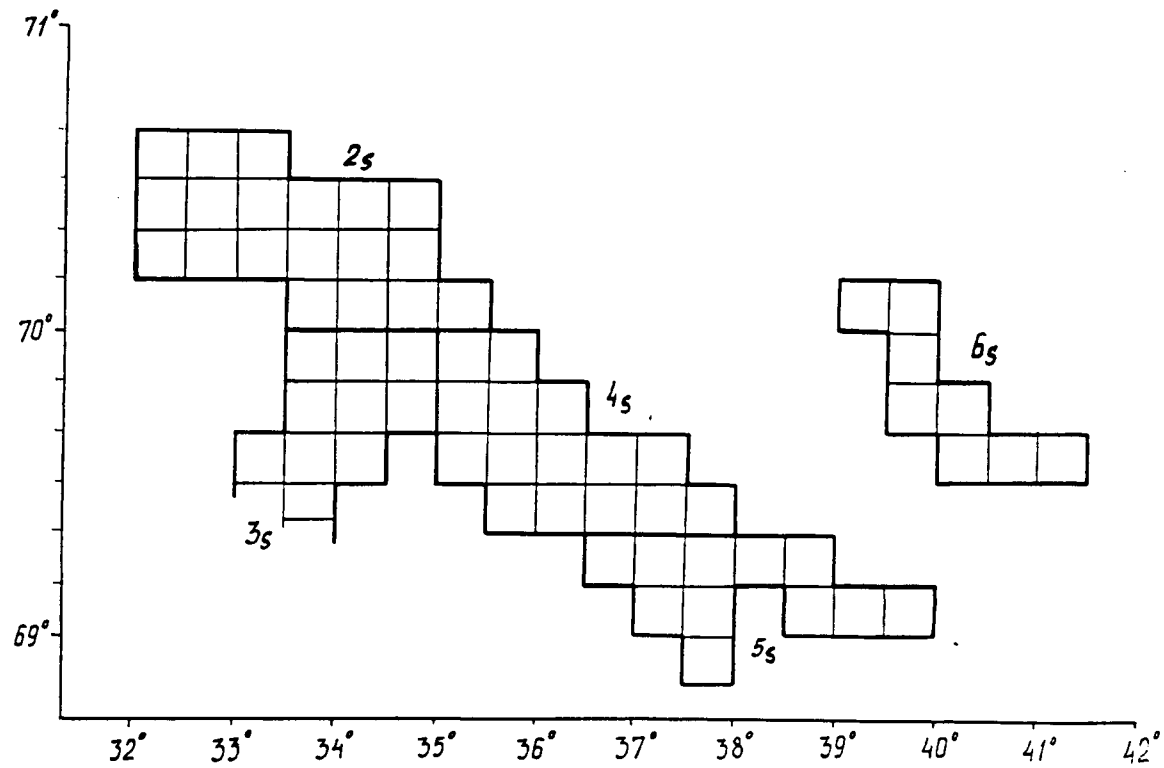


Fig. 4. Sampling strata used in the Barents Sea in the Russian zone at the Kola Coast.

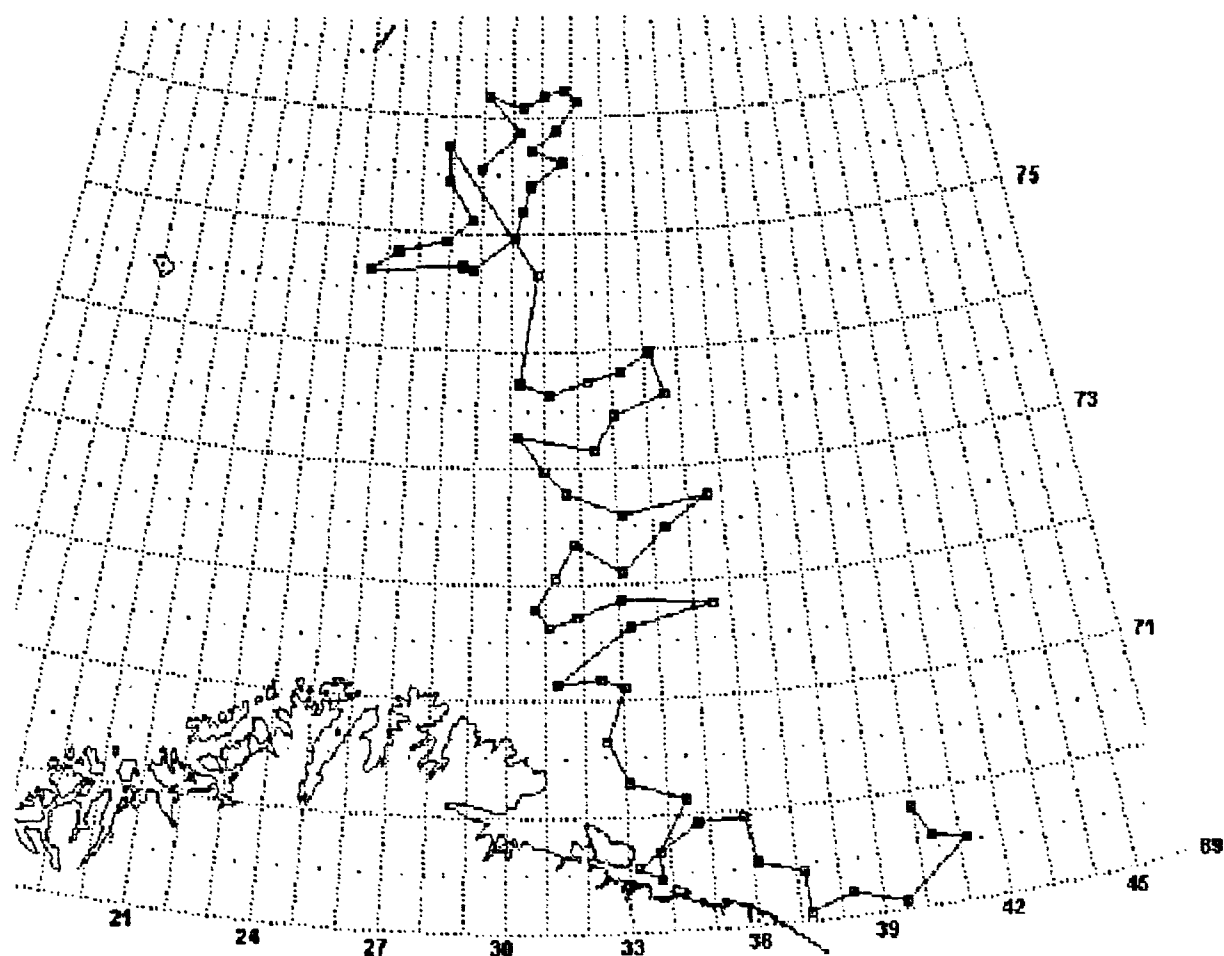


Fig. 5. Stations and cruise route of the Russian vessel R/V 'Kapitan Rogozin' in the Barents sea in April - May 1994.

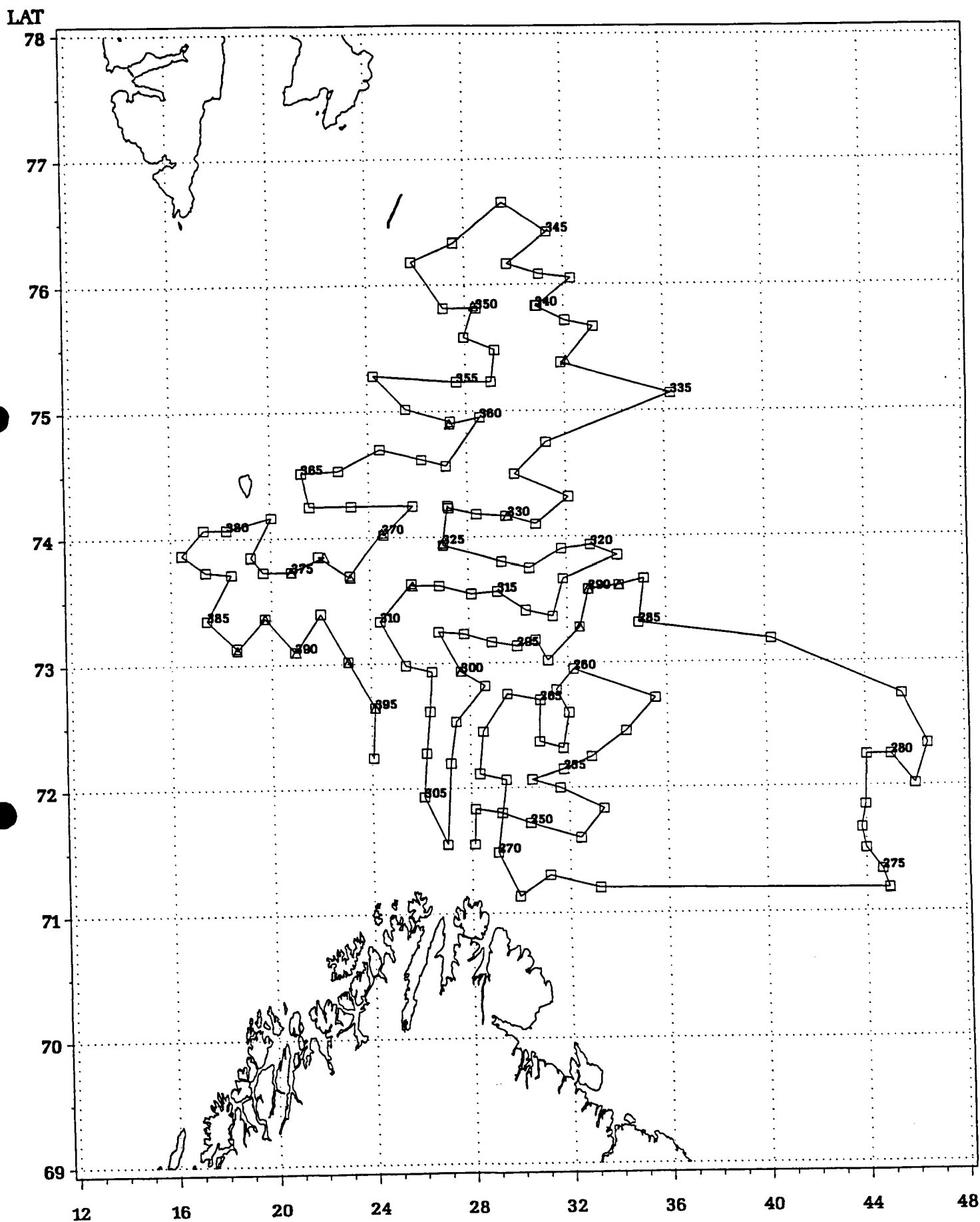


Fig. 6. Stations and cruise route of the Norwegian vessel R/V Jan Mayen in the Barents sea in April - May 1994.

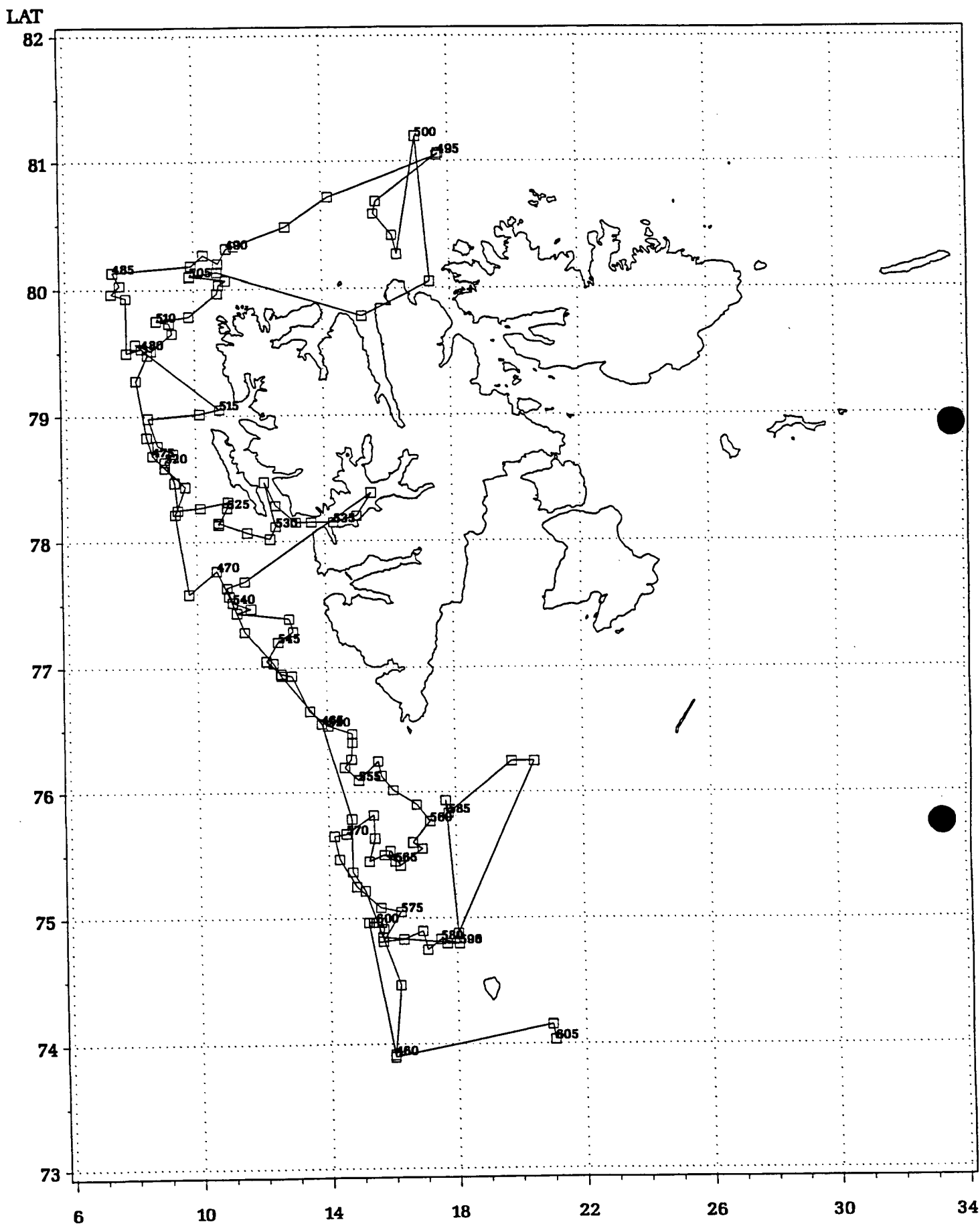


Fig. 7. Stations and cruise route of the Norwegian vessel R/V 'Jan Mayen' in the Svalbard area in June 1994.

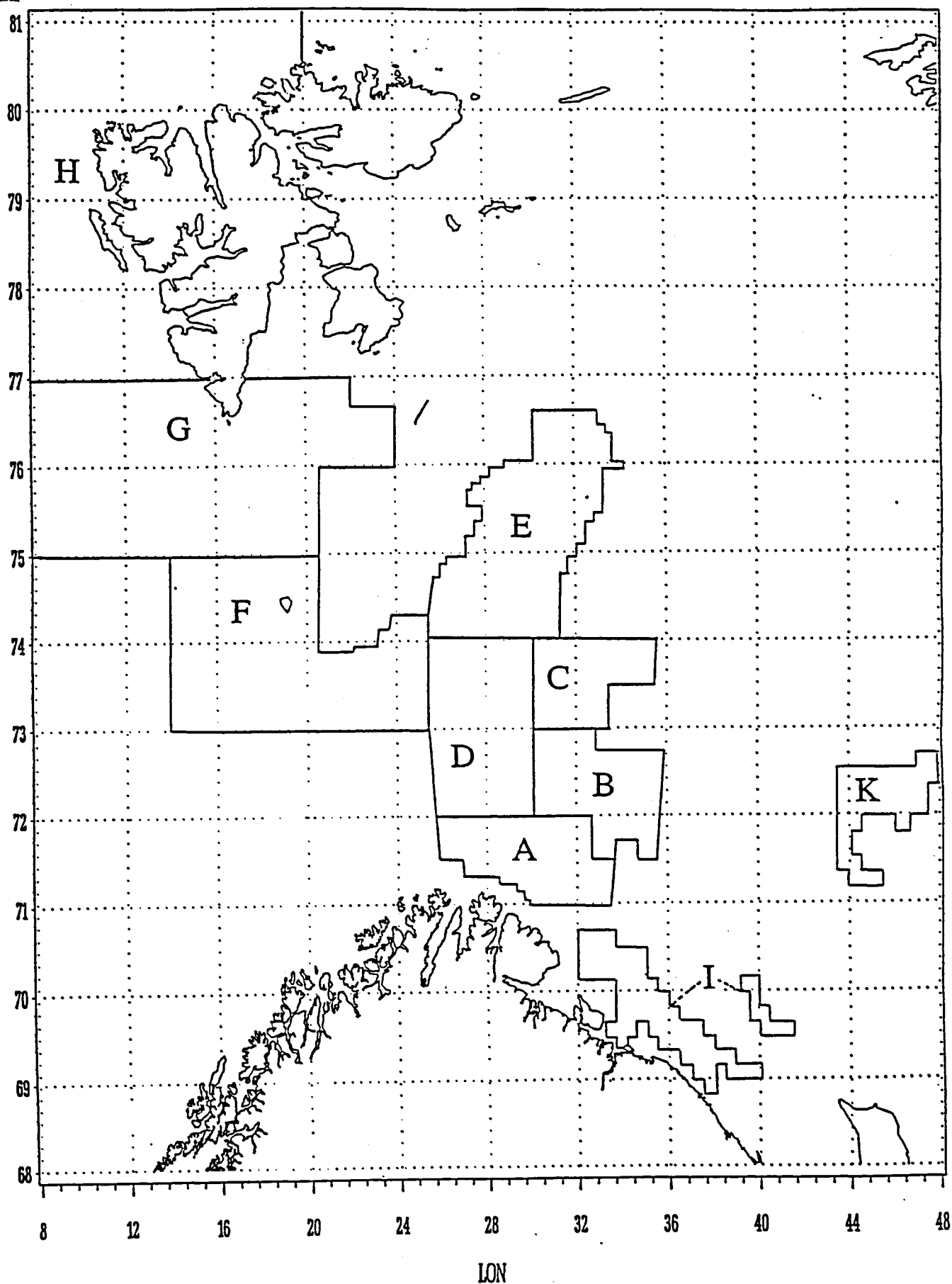


Fig. 8.

Strata are combined to larger areas reflecting fishing grounds: Kola Coast (I), Goose Bank (K), East Finnmark (A), Tiddly Bank (B), Thor Ivertsen Bank (C), Hopen (E), Bear Island (F), Storfjord Trench (G) and Spitsbergen (H).