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RESULTS OF A STRATIFIED BOTTOM TRAWL SURVEY FOR SHRIMPS (PANDALUS BOREALIS) IN THE SPITSBERGEN AREA IN JULY 1982

by

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ABSTRACT

A stratified random bottom trawl survey of the shrimp grounds in the Spitsbergen area between N74°00' and N80°30', and between E08°00' and E18°00' was made in July 1982. On the basis of the data from 41 trawl stations the biomass of shrimps, Pandalus borealis, in the area surveyed was estimated by the swept area method to be about 40 000 tonnes. The by-catches of fish in the hauls are also discussed.

INTRODUCTION

A stratified random sampling scheme was carried out during a bottom trawl survey with R/V "Michael Sars" from 12 July to 1 August 1982 in the Spitsbergen waters. (Division 2b).

The objectives of the cruise were to study the structure of the shrimp stock, the by-catches of fish and to estimate the abundance of shrimps.

MATERIAL AND METHODS

The cruise in July 1982 covered the area from the "Kveithola" and northwards along the western slope at West-Spitsbergen up to north of Spitsbergen (N80°30'). The stratified areas (Fig. 1) were at depths from 200 m to 400 m. The sampling localities are indicated in Fig. 2.

The distance trawled in the hauls was 3.0 nautical miles, but on station no. 17 trawling had to be made shorter due to rough bottom. In the area north and west of Bjørnøya (Kveithola) 8 trawl hauls were taken due to the great numbers of small cod in the area. The stations are listed in the bottom of Table 1 and 6. The distance trawled in these extra hauls was 1.5 nautical miles (½ hour).

The shrimp samples were treated as described in TEIGSMARK & ØYNES (1981). By-catches of fish were counted and length measurements were taken of all important species. The catch of shrimps (in kg) and by-catch of fish (in numbers) are listed in Table 1.

RESULTS AND DISCUSSION

Shrimps

Table 2 gives the estimated biomass of the shrimp stock in each stratum, giving 40 400±13 200 tonnes for the entire area investigated. This corresponds to $(7.3\pm2.4)\cdot10^9$ individuals (Table 3). The commercial stock was estimated to be 36 400±12 000 tonnes (Table 4) corresponding to $(6.1\pm2.0)\cdot10^9$ individuals (Table 5). The highest shrimp concentrations were found in the northernmost strata, where catches close to 1 ton/trawling hour were taken. The catches within the Spitsbergen area were much more variable than in the Barents Sea.

Table 6 gives the estimated densities of males, intersexes and females in the different strata. The average concentrations of large males (carapace length $\geq$ 16 mm), intersexes and females

were close to the average for the Barents Sea. The concentrations of young males (carapace length < 16 mm) were, however, low, on the average only 50% of what was found in the Barents Sea. For the Spitsbergen area this indicates poor prospects for a good fishery beyond a period of a few years. However, due to the very variable distribution of the different sexes, it may perhaps be possible to locate minor areas of high concentrations that can be the basis for a profitable fishery.

A very high variability in both the biological characteristics of the shrimps and in the catches is the most characteristic feature of the shrimp stock in the Spitsbergen region. Areas are known where both growth and yearclass strength vary significantly within a distance of only a few nautical miles (TEIGSMARK, unpubl. data). Some of the samples from Spitsbergen area also contain only one or a few yearclasses, indicating a very variable and local settling of the shrimp-larvae within the region.

Samples taken in 1978 showed that the females were biennial spawners in most of the Spitsbergen area (TEIGSMARK, unpubl. data) corresponding to what was observed by RASMUSSEN (1953). In 1980 it was discovered that the females had changed to an annual spawning pattern in most of the area, and this annual female spawning was observed on this cruise too. Actual spawning had not yet started to any significant extent on this cruise. The intersexes in the Spitsbergen area were generally larger than observed in the Barents Sea, and their size seemed to increase northwards.

This is the first Norwegian cruise carried out to specifically estimate the biomass of the shrimp stock in the Spitsbergen area. Due to lack of time, only depths between 200 and 400 meters were investigated. It is quite clear that significant concentrations of shrimps exist outside this depth interval. It is therefore preferable that the investigated area is extended down to 500 m on future cruises.

By-catches

In Table 1 are listed by numbers the most important by-catches of the most economically important fish species for each trawl haul. Table 7 gives the by-catches (in numbers) in each stratum investigated. The numbers of fish are listed as mean number per hour trawled i.e. per 3 nautical miles. In TEIGSMARK and ØYNES (1982) are given the by-catches in shrimp trawling in the Barents Sea north to the Hopen- and Bjørnøya islands. The by-catch of cod in all the areas investigated was very low except for the area southeast of Bjørnøya. The present investigation showed that this relatively high density of cod continued further north from Bjørnøya area and up along the West-Spitsberg to N78°30'. The highest numbers of cod was found northwest of Bjørnøya in the Kveithola area (Strata 1 and 2). In these areas 8 extra trawl hauls were taken in depth from 116 to 250 m. The mean numbers of cod from these hauls were more than 800 individuals per hour trawled with the highest numbers at station no. 46 with 1649 cods per hour trawling (Table 1). The cod were small, 75% were less than the minimum length (42 cm) legalized for commercial fishing.

Haddock were found in some numbers in strata 4 and 6 i.e. the most shallow part of the fields south of Spitsbergen. Most of the specimens were 0-group haddock.

The redfish were numerous in strata 3 and 6 with numbers from 2000 to 3500 individuals per hour trawling.

The Greenland halibut were present in the deepest strata investigated, most numerous in strata 3 and 10 with 218 and 478 individuals per trawled hour, mostly to small to be accepted for consumption. Capelin were present in all the strata investigated. In strata 11 and 13 the capelin was the major catch with up to 2.5 tonnes per hour trawling. The polar cod was present i all the Spitsbergen area, most numerous i stratum 10 (north of Isfjord) with more than 10 000 individuals per hour trawling.

REFERENCES

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Table 1. Trawl station data from cruise with R/V "Michael Sars" on Vest-Spitsbergen and Kvitøya in July 1982.

St. nr.	Date	Stratum	Square	Trawl. time	Dist. n.m.	Position N	Position E	Trawl. dir.	Depth (m)	Shrimp catch (kg)	By-catches (number) Cod	Haddock	Redfish	Gr.Hal.	Capelin	Polar cod	Other
5	17/7	1	5	0845-0945	3.0	74°18'	16°00'	180°	367-300	5	9		460	15			622
3	16/7	1	15	1700-1800	3.0	74°15'	16°27'	360°	335-330	5	31		215		59	26	645
4	17/7	2	8	0620-0720	3.0	75°02'	16°10'	180°	280-230	2	17		432		484		484
9	17/7	2	15	1625-1725	3.0	74°53'	17°49'	270°	300-234	91	57		49	16	385	3	1212
2	16/7	2	27	1440-1538	3.0	74°15'	16°53'	350°	222-243	3	11		605				1268
44	27/7	3	9	0745-0845	3.0	75°59'	16°25'	160°	367-366	158			20	300	170	620	580
15	19/7	3	15	0620-0720	3.0	75°49'	15°28'	350°	390-390	60			36	160	184	756	340
14	18/7	3	26	1725-1825	3.0	74°40'	15°55'	050°	383-370	170	7		4630	220	1430	680	674
12	18/7	3	35	1200-1258	3.0	75°30'	15°35'	050°	381-380	190	199		5303	343			336
11	18/7	3	38	0900-1000	3.0	75°24'	14°45'	010°	394-388	75	41		1680	65	62		667
13	18/7	4	11	1455-1557	3.0	75°31'	16°14'	050°	276-275	318			102		7721	501	110
10	18/7	4	14	0620-0720	3.0	75°16'	15°23'	010°	285-276	1	98	59	962		312		463
19	20/7	5	4	0620-0720	3.0	76°38'	13°43'	310°	335-334	54			1530	23		23	298
16	19/7	5	20	0850-0950	3.0	76°01'	15°13'	330°	356-348	285	2		126	35	754	178	292
17	19/7	5	23	1140-1225	2.5	76°03'	15°52'	130°	397-391	55			14	113	77	936	162
20	20/7	6	1	0910-1010	3.0	76°54'	13°12'	010°	240-212	40	10	2	36		1800	964	492
18	19/7	6	8	1755-1855	3.0	76°26'	14°14'	310°	236-228	10	135	149	6989		10	169	501
27	22/7	8	1	1015-1115	3.0	78°01'	09°37'	360°	340-324	324			1656	96	48	48	398
23	20/7	8	6	1730-1830	3.0	77°26'	11°18'	350°	356-350	63	96		342	36	1521	36	243
26	22/7	9	5	0620-0720	3.0	77°39'	11°10'	030°	290-290	180	1	2	120	300	1170	1095	1735
22	20/7	9	9	1535-1630	3.0	77°24'	11°28'	360°	294-274	127	14		1384		200	184	118
21	20/7	9	24	1200-1258	3.0	77°11'	12°53'	350°	204-200	47			32		544	736	1784
31	23/7	10	2	0620-0720	3.0	78°48'	08°45'	350°	360-337	640			663	153		119	542
29	22/7	10	11	1545-1645	3.0	78°13'	10°58'	280°	334-303	146	96			792	94 kg	204 kg	94 kg
32	23/7	11	2	0900-1000	3.0	78°56'	08°46'	230°	285-242	9	6		220		2190	40	197
34	23/7	11	8	1355-1455	3.0	78°58'	10°12'	080°	270-254	92				217	1500 kg	233	917
33	23/7	11	13	1130-1228	3.0	78°53'	09°20'	030°	214-200	170					2000 kg		
28	22/7	11	28	1340-1438	3.0	78°08'	11°03'	360°	265-230	120					2500 kg		719
24	21/7	11	31	0620-0720	3.0	78°06'	11°50'	110°	280-245	280	2			168	1239	2814	7090
30	22/7	11	16	1840-1940	3.0	78°33'	09°43'	030°	295-275	248	17	1	610	15	1065	465	440
25	21/7	11	44	0850-0950	3.0	78°02'	12°45'	070°	273-260	115				208			224
38	24/7	12	3	1720-1820	3.0	19°41'	09°32'	020°	366-350	530			364	39	39	13	590
36	24/7	12	8	1110-1210	3.0	79°20'	08°12'	350°	355-346	0							Stone and mud
37	24/7	13	8	1525-1625	3.0	79°33'	09°10'	030°	245-260	353			990		36	72	428
35	27/7	13	8	0840-0940	3.0	79°06'	08°47'	320°	250-240	0	3				500 kg		1
42	25/7	14	1	1530-1628	3.0	80°06'	10°54'	190°	370-350	545			486	108	54	108	810
40	25/7	14	2	1020-1120	3.0	80°11'	10°50'	190°	350-330	978			615		328	41	822
41	25/7	15	1	1245-1343	3.0	80°06'	11°02'	190°	273-270	575			952			56	1448
39	25/7	15	3	0800-0900	3.0	80°18'	11°20'	260°	225-202	24			18		28 kg	72	56
6	17/7	extra haul		1135-1205	1.5	74°43'	16°50'	140°	168-165	0	160	5	26				186
7	17/7	— " —		1325-1355	1.5	74°43'	17°34'	270°	117-116	0	71		22				371
8	17/7	— " —		1507-125	1.5	74°46'	17°32'	090°	276-274	0	16		18			24	687
43	26/7	— " —		0625-1700	1.5	80°04'	10°55'	190°	503-490	66			12	27		333	100
45	27/7	— " —		1215-1245	1.5	75°32'	15°36'	230°	257-254	80	26		2275	125	25	100	200
46	27/7	— " —		1705-1735	1.5	74°56'	16°37'	110°	224-218	0	82		70		20	10	960
47	27/7	— " —		2005-2035	1.5	74°41'	16°47'	080°	219-217	0	874	(not counted)					90 kg
1	16/7	— " —		1132-1202	1.5	73°51'	16°35'	300°	360-354	5	38		1148	4	476		244

Table 2. Estimated density ($\bar{c}_k$) and biomass in each stratum and estimated biomass in all strata summarized with the precision of the estimates.

Stratum	Area (nm^2)	Number of Hauls	$\bar{c}_k$ Tons/$(nm)^2$	s_k^2	$v(\bar{c}_k)$	Coeff. of var. (S.E./$\bar{c}_k$)	Biomass (tons)	S.E. of biomass
1	284	2	0.264	0.000	0.000	0.000	75	0.000
2	842	3	1.688	7.269	2.423	0.922	1422	1311.279
3	1189	5	6.891	9.679	1.936	0.202	8193	1654.185
4	486	2	8.416	139.880	69.940	0.994	4088	4062.755
5	611	3	7.123	47.080	15.693	0.556	4351	2419.674
6	353	2	1.319	1.253	0.626	0.600	466	279.541
8	109	2	10.210	94.824	47.412	0.674	1111	749.158
9	539	3	6.226	12.481	4.160	0.328	3359	1100.396
10	201	2	20.736	339.697	169.848	0.628	4162	2615.641
11	815	7	7.794	24.238	3.463	0.239	6354	1516.926
12	155	2	13.982	391.011	195.506	1.000	2164	2164.466
13	89	2	9.313	173.455	86.723	1.000	833	832.561
14	58	2	40.179	260.984	130.492	0.284	2270	645.417
15	95	2	15.803	422.611	211.306	0.920	1506	1385.314
					All strata		40353	6747.089

Table 3. Estimated number of shrimps per square nautical mile in the different strata and for all strata summarized with the precision of the estimates.

Stratum	Area (nm^2)	No. of hauls	$\bar{c}_k \cdot 10^{-3}$	$s_k^2 \cdot 10^{-6}$	$v(\bar{c}_k) \cdot 10^{-6}$	Coeff. of var.	Stock$\cdot 10^{-6}$	S.E. of stock 10^{-6}
1	284	2	63.807	0.000	0.000	0.003	18.108	0.051
2	842	3	393.821	393.792	131.264	0.920	331.755	305.205
3	1189	5	1314.708	350.383	70.077	0.201	1563.056	314.725
4	486	2	1777.466	6254.570	3127.285	0.995	863.493	859.095
5	611	3	1235.515	1225.906	408.635	0.517	754.653	390.451
6	353	2	207.372	19.314	9.657	0.474	73.244	34.709
8	109	2	1966.787	4527.525	2263.763	0.765	213.986	163.698
9	539	3	1178.187	436.710	145.570	0.324	635.632	205.839
10	201	2	3869.430	3172.895	1586.448	0.326	776.595	252.790
11	815	7	1322.477	861.043	123.006	0.265	1078.083	283.909
12	155	2	2169.509	9413.541	4706.771	1.000	335.840	335.840
13	89	2	1102.697	2431.883	1215.941	1.000	98.581	98.581
14	56	2	6571.596	6213.176	3106.588	0.268	371.284	99.584
15	95	2	2419.943	9666.484	4833.242	0.908	230.621	209.514
					All strata		7344.931	1214.511

Table 4. 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.

Stratum	Area (nm^2)	Number of Hauls	$\bar{c}_k$ Tons/$(nm)^2$	s_k^2	$v(\bar{c}_k)$	Coeff. of var. (S.E./$\bar{c}_k$)	Biomass (tons)	S.E. of biomass
1	284	2	0.216	0.000	0.000	0.002	61	0.135
2	842	3	1.409	5.063	1.688	0.922	1186	1094.317
3	1189	5	6.157	7.973	1.595	0.205	7320	1501.358
4	486	2	7.253	103.820	51.910	0.993	3524	3500.129
5	611	3	6.538	41.156	13.719	0.567	3993	2262.334
6	353	2	1.232	1.196	0.598	0.628	435	273.162
8	109	2	9.027	68.224	34.112	0.647	982	635.451
9	539	3	5.539	10.008	3.336	0.330	2988	985.360
10	201	2	18.896	325.250	162.625	0-675	3792	2559.417
11	815	7	7.116	20.559	2.937	0.241	5801	1397.058
12	155	2	13.072	341.751	170.876	1.000	2024	2023.536
13	89	2	0.102	165.675	82.837	1.000	814	813.675
14	56	2	37.325	230.101	115.051	0.287	2109	606.028
15	95	2	14.817	373.072	186.536	0.922	1412	1301.590
					All strata		36442	6131.115

Table 5. Estimated commercial number of shrimps per square nautical mile in the different strata and for all strata summarized with the precision of the estimates.

Stratum	Area (nm^2)	Number of hauls	$\bar{c}_k \cdot 10^{-3}$	$s_k^2 \cdot 10^{-6}$	$v(\bar{c}_k) \cdot 10^{-6}$	Coeff. of var.	Stock$\cdot 10^{-6}$	S.E. of stock 10^{-6}
1	284	2	49.849	0.001	0.001	0.014	14.147	0.203
2	842	3	290.658	213.346	71.115	0.917	244.850	224.646
3	1189	5	1074.915	228.252	45.650	0.199	1277.967	254.020
4	486	2	1434.400	4070.406	2035.203	0.995	696.832	693.043
5	611	3	1086.051	1033.247	344.416	0.540	668.360	358.460
6	353	2	186.291	18.702	9.351	0.519	65.798	34.154
8	109	2	1616.334	2662.690	1481.345	0.753	175.857	132.421
9	539	3	973.278	287.933	95.978	0.318	525.084	167.138
10	201	2	2897.885	6175.729	3087.865	0.606	581.605	352.676
11	815	7	1097.909	513.767	73.395	0.247	895.015	220.851
12	155	2	1967.498	7742.098	3871.049	1.000	304.569	304.569
13	89	2	1063.296	2261.199	1130.599	1.000	95.059	95.059
14	56	2	5862.052	5074.771	2537.385	0.272	331.206	90.000
15	95	2	2199.403	8014.965	4007.482	0.910	209.603	190.778
					All strata		6080.951	1043.975

Table 6. Density estimates (thousand individuals per sq. nautical mile) for small males (CL<16mm), large males (CL≥16mm), intersexes and females in the different strata.

Stratum	Males<16 mm	Males≥16 mm	Intersexes	Females
1	6.171	49.933	6.275	1.428
2	76.512	231.188	26.682	59.438
3	168.893	739.735	200.443	205.637
4	132.737	1255.753	211.239	177.737
5	49.384	804.286	280.549	101.296
6	4.858	107.481	58.184	36.848
8	82.554	1539.844	135.779	208.611
9	88.942	861.339	106.433	121.473
10	803.408	2280.677	257.684	527.661
11	143.647	725.860	180.301	272.668
12	25.982	1682.344	175.379	285.804
13	0.000	595.786	236.998	269.914
14	251.887	5231.725	682.983	404.802
15	1.853	1730.366	399.763	287.961

Table 7. By-catch composition taken in different strata in the Spitsbergen area in July 1982.

Stratum number	Number of hauls	By-catch of fish in numbers pr 3 n.m. trawled							
		Cod	Haddock	Redfish	Gr.Hal.	Capelin	Polar cod	Long rough dab	Others
1	2	20		338	8	30	13	246	388
2	3	28		362	5	290	1	805	183
3	5	50		2334	218	369	411	354	166
4	2	49	30	532		4017	251	245	42
5	3	1		557	57	277	379	139	111
6	2	73	76	3510		905	567	283	215
8	2	48		999	66	785	42	122	199
9	3	5	1	512	100	638	672	576	792
10	2	48		331	478	4700	10260	833	594
11	7	4		119	87	86356	507	224	1431
12	2			182	20	20	7	98	198
13	2	2		495		25018	36	167	28
14	2			551	54	161	75	479	387
15	2			485		1564	64	591	164
St.no. 6-8 and 45-47	6	410	2	804	42	15	45	954	80

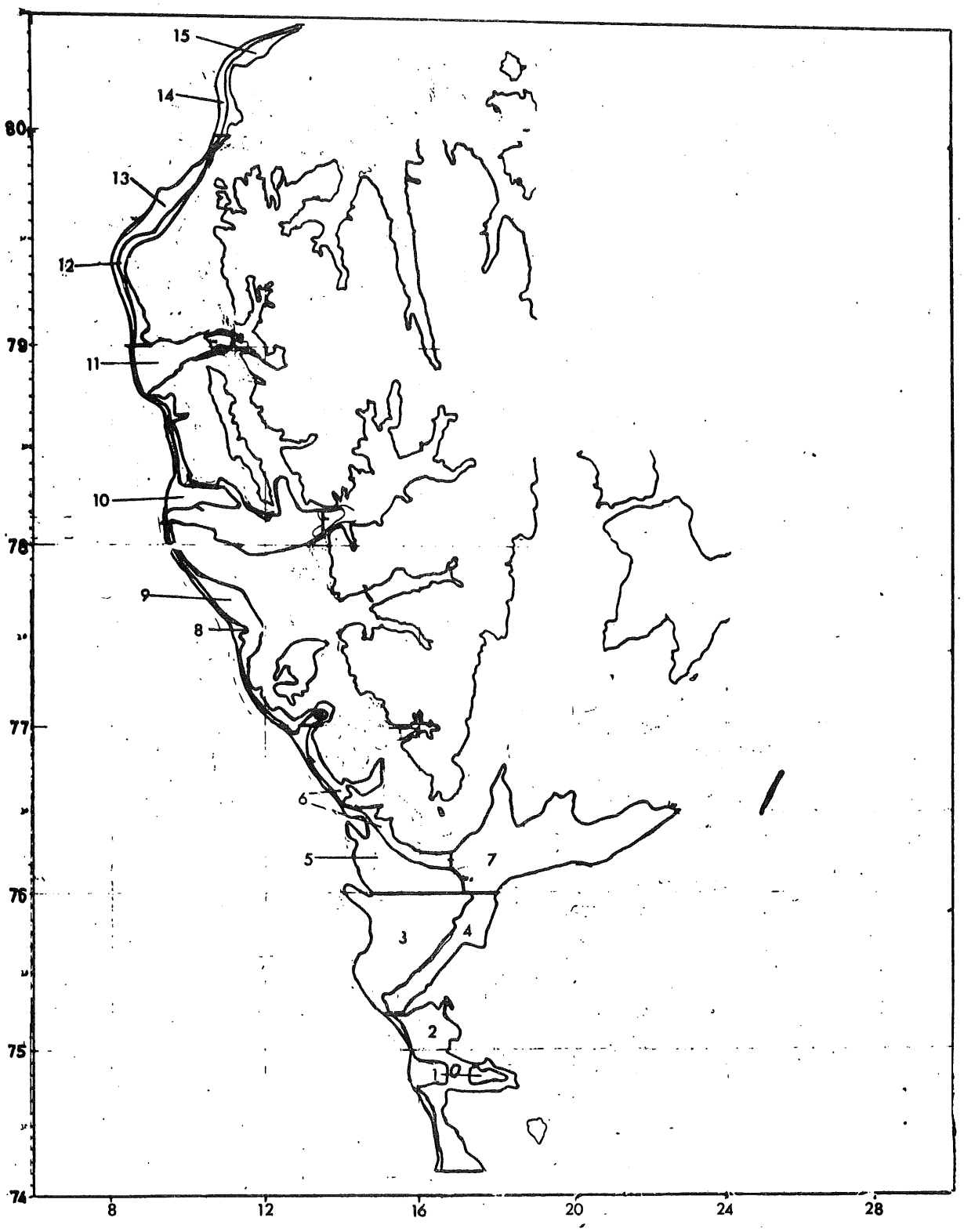

Fig. 1. Sampling strata used in July 1982 in the Spitsbergen area for the shrimp survey with R/V "Michael Sars".

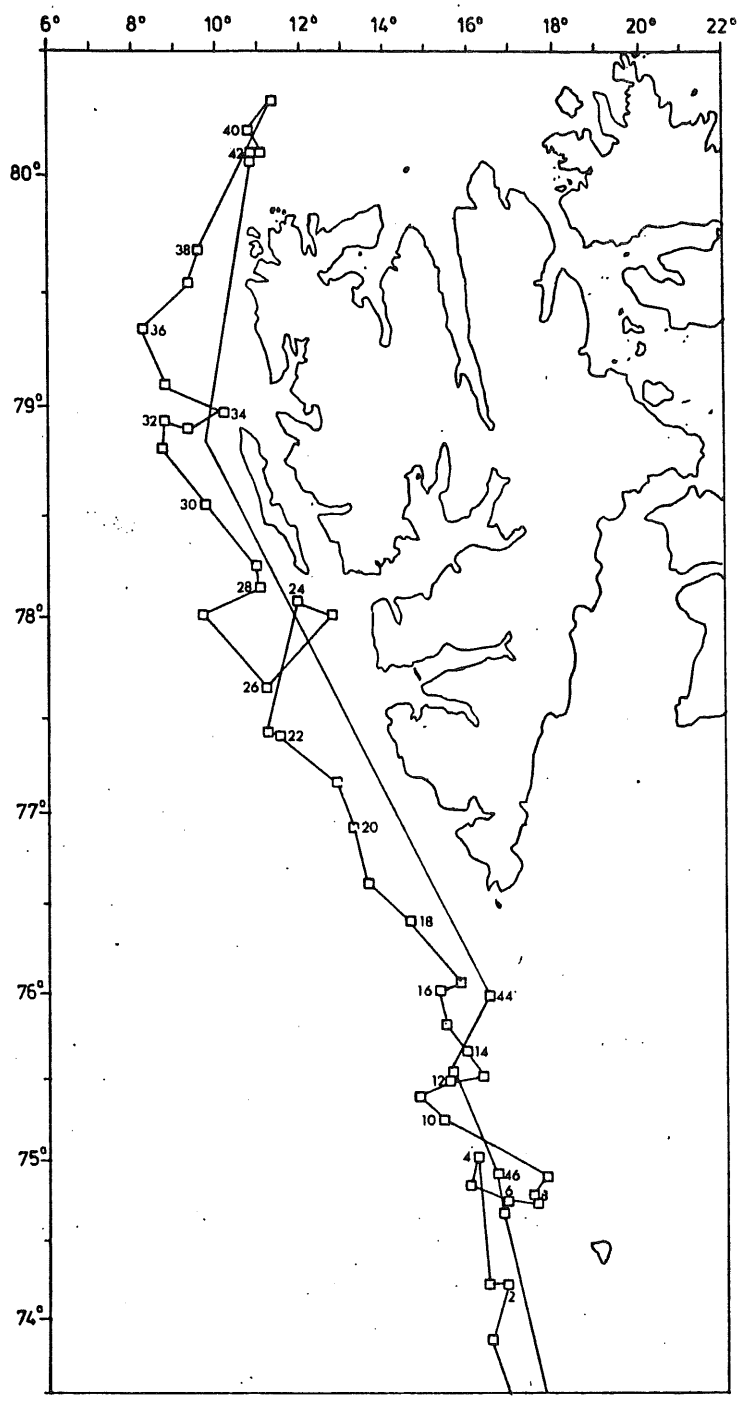

Fig. 2. Bottom trawl stations.