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RESULTS OF NORWEGIAN AND RUSSIAN INVESTIGATIONS OF SHRIMP (*Pandalus borealis*) IN THE Barents Sea AND SVALBARD AREA IN 1992

by

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ABSTRACT

The results of the Russian and Norwegian surveys for shrimp, *Pandalus borealis*, in the Barents Sea in spring and the Svalbard area in autumn 1992 are presented in this paper. The survey results are presented by nation but the discussion is given combined. Biomass, size- and sex frequency will be presented for subareas.

The data from both countries show similar trends. They indicate that the shrimp biomass in the Barents Sea has decreased with approximately 15 % since 1991. The Hopen area and the Bear Island trench area show the largest reduction. However, there is a slight increase in the biomass north of 75°30'N, this may be due to warmer sea temperatures.

The Svalbard area was investigated only by the Norwegians. New areas were covered north of Svalbard. An increase in the biomass is observed in the Svalbard area.

INTRODUCTION

Shrimp surveys in the Barents Sea and in the Svalbard area have been undertaken since 1982 by Norwegian vessels and since 1984 by Russian vessels. In 1992 the first joint paper on these shrimp investigations was presented (Berenboim *et al* 1992). However, different methodology did not allow a joint presentation of data. In June 1992 we agreed upon common methodology and consequently comparable results can be presented. The cooperation in evaluating the stocks of shrimp in the northern areas is important in order to improve the use of the results, preferably into a basis for fisheries regulation.

MATERIAL AND METHODS

The survey area and the stratification of the survey area are given in figures 1 and 2. The stratification of the area is almost the same as earlier years. However, new numbering of the Svalbard strata including areas shallower than 200 m depth were

introduced in order to give compatibility to demersal fish surveys.

The Norwegian sampling trawl used is the standard sampling trawl to all bottom trawl surveys. It is a modified shrimp trawl with a "rockhopper" ground gear. The "sweep width" is set at 11.7 m for shrimp surveys resulting in a swept area of a three nm haul of 0.01895 sq.nm. The trawling was conducted by a speed of three knots for 20 min in the Barents Sea area and 30 min in the Svalbard area.

The Russian trawl used is the standard trawl of all russian surveys for shrimp. The "sweep width" is set at 15.5 m and the coefficient of trawl efficiency is set to 0.182 resulting in a swept area of a three nm haul of 0.00457 sq.nm. The trawling was conducted with a speed of three 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 from 8th of May to 6th of June by the stern trawler R/V "Kapitan Shaitanov". The survey in the Svalbard area was not conducted due to economical problems. The Norwegian survey was conducted in the Barents Sea from 2nd to 30th of May and in the Svalbard area from 19th of August to 18th September by the stern trawler M/T "Gargia". The trawl stations and the survey tracks are given in figures 3 and 4. The method of conducting the survey and making the calculations are described by Teigsmark and Øynes (1982) and Berenboim *et al* (1987).

During a summing-up meeting in Tromsø in June 1992 it was agreed upon common methods of sex determination on shrimp. The categories and definitions used by Norwegian and Russian counterparts are given in table 1. In this paper the Russian categories are used to give a comparable sex distribution.

RESULTS

The Russian survey in the Barents Sea covered the strata 1c, 2, 3, 4, 6, 7, 10, 11, 12, 14, 15, 16, 17 and 18 with 62 stations (Table 2). The Norwegian survey covered all strata except 1c with 146 stations (Table 3). In the Svalbard area the Norwegian survey covered 25 strata with 191 stations (Table 4).

Strata are combined into larger areas reflecting main fishing grounds. Biomass in each area for the years that the survey has been carried out together with the percentage change from 1991 to 1992 are presented in tables 5 and 6.

Length frequencies divided into sexual maturity stages are given for the different areas in figures 6 a-f.

DISCUSSION

There is a general reduction in shrimp biomass in the Barents Sea since 1991. Russian data show a reduction of 12 % whereas the Norwegian survey show a reduction of 40 %. As the Hopen area is the area with the highest biomass over time it now also shows drastic reduction in biomass, according to Russian data 24 % and Norwegian data 47 %. The more drastic reduction in Norwegian data is partly explained by technical problems during trawling. Especially in the Hopen

area and the area of Bear Island Trench sampling problems occurred on stations that earlier years have presented a high biomass. However, on the whole the reduction in shrimp biomass is real and is estimated to be approximately 15 %.

Russian data show an increase at Tiddly Bank and a slight increase in Northern parts of the Hopen area.

The temperature in the Barents Sea the four last years have been above the long time mean (1970-1989) due to large quantities of Atlantic water flowing in to the Barents sea. The most drastic changes in temperature have been observed in the Northeastern Barents Sea. (Loeng, H. pers. comm.)

Russian hydrological data for 1992 (Tereshenko, V. pers. comm.) shows that the bottom temperature in the Hopen area was 0.9°C higher than the long time mean. On the Thor Ivertsen Bank and the Tiddly bank the warm Atlantic water masses were distributed approximately 30 nm. further east than in earlier years.

The expanded area of warm water and relatively high water temperatures the last years may be a reason to an increase in the biomass of shrimp in the northern parts of the Hopen area and at the Tiddly Bank.

The Norwegian data show an increase of biomass in the Storfjord Trench of 14 % and in the Spitsbergen area of 210 %. The high increase in the Spitsbergen area is not real because the investigated area is almost doubled as areas north of 80°N are included. However, the increase is obvious and if only strata 51-60 are included the increase is still 60 %.

The high reduction in the shrimp biomass in the Barents Sea may be explained by the increasing predation by cod as a consequence of lower biomass of other prey species such as herring and capelin (Nilssen & Hopkins 1991). The reduction in the capelin stock registed in autumn 1992 (Gjøsæter, H. pers. comm.) is therefore one possible reason to biomass reduction in the Barents Sea.

Heavy fishing pressure since 1989 may also explain some of the reduction of shrimp biomass in the Barents Sea (see Table 7.)

A comparison in size frequency (Fig. 6) shows that there is a similar size composition in Russian and Norwegian data from the different areas. Thereby we know that the different equipment does not influence the size distribution of the shrimp cached. However, the Norwegian trawl seems to sample a few individuals more in the size group smaller than 10 cm. This will not influence the biomass estimates but the presence of small individuals in the sample is important when trying to determine the age of the shrimp on the basis of modal groups.

The sex distribution within each size group is also very similar especially in area C and E. In area A and B the Norwegian data has a bigger amount of individuals characterised as transition stage. This is explained by several factors. The Norwegian samples from the area A are taken two weeks earlier and further West than the Russian data. The different sex distribution is probably also explained by a small difference in characterising the individuals on the border between

transitional and female 1 in the first maturity stage. Thereby individuals belonging to the transitional stage in the Norwegian data are grouped as female 1 in the Russian data in area A and B. However, this doesn't make any difference in interpreting the data as both groups will be first time spawners.

CONCLUSIONS

Both Norwegian and Russian data show a reduction in the biomass in the Barents Sea since 1991. There is an obvious relocation of the biomass to the northern and northeastern parts of the Barents Sea, which may be explained by the warmer temperatures during the last four years. The methodology seems to be satisfactory on both sides and the data are thereby easy to compare.

Further improvement by correlating and calibrating methodology will allow even more advanced cooperation. One solution would be to divide the survey area into a Norwegian and a Russian part with a smaller area as a common survey area for calibration. This would make the sampling more efficient and less expensive.

REFERENCES

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 in 1991. ICES C.M. 1992/K:39

Hylen, A., K. Sunnanå and P. Øynes. 1989. Results of stratified surveys for shrimp (*Pandalus borealis*) in the Barents Sea and in the Svalbard region in 1989. ICES C.M. 1989/K:26

Muchin, S.G. and G.K. Shevaleva 1991. Soviet investigations on shrimp in the Barents Sea and off Spitsbergen in 1990. ICES C.M.1991/K:14

Nilssen, E.M. & C. Hopkins 1992. Regional variability in fish-prawn communities and catches in the Barents Sea, and 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

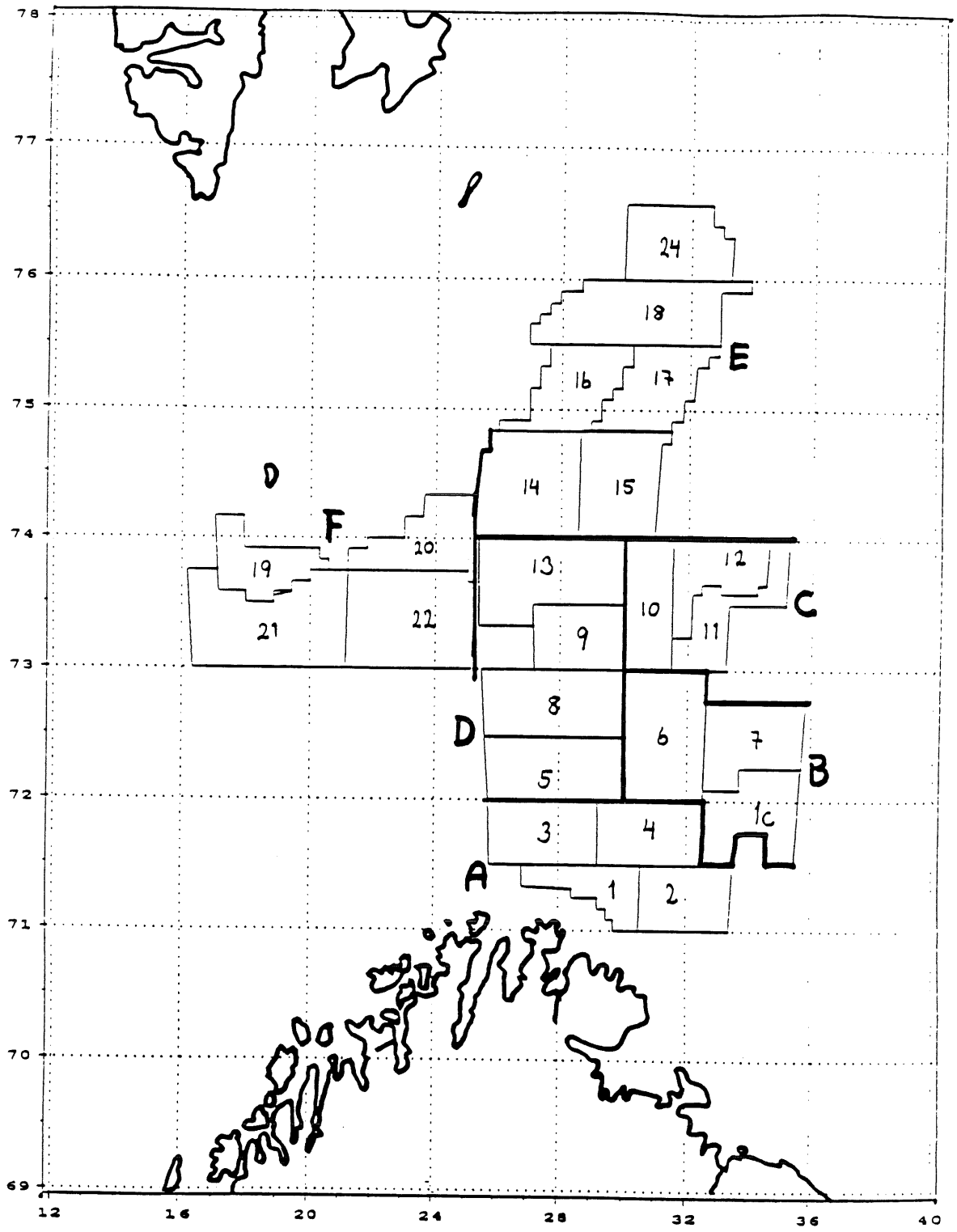

Figure 1. Sampling strata used in the Barents Sea for the shrimp surveys. Divisions into main areas are given as letters A to F.

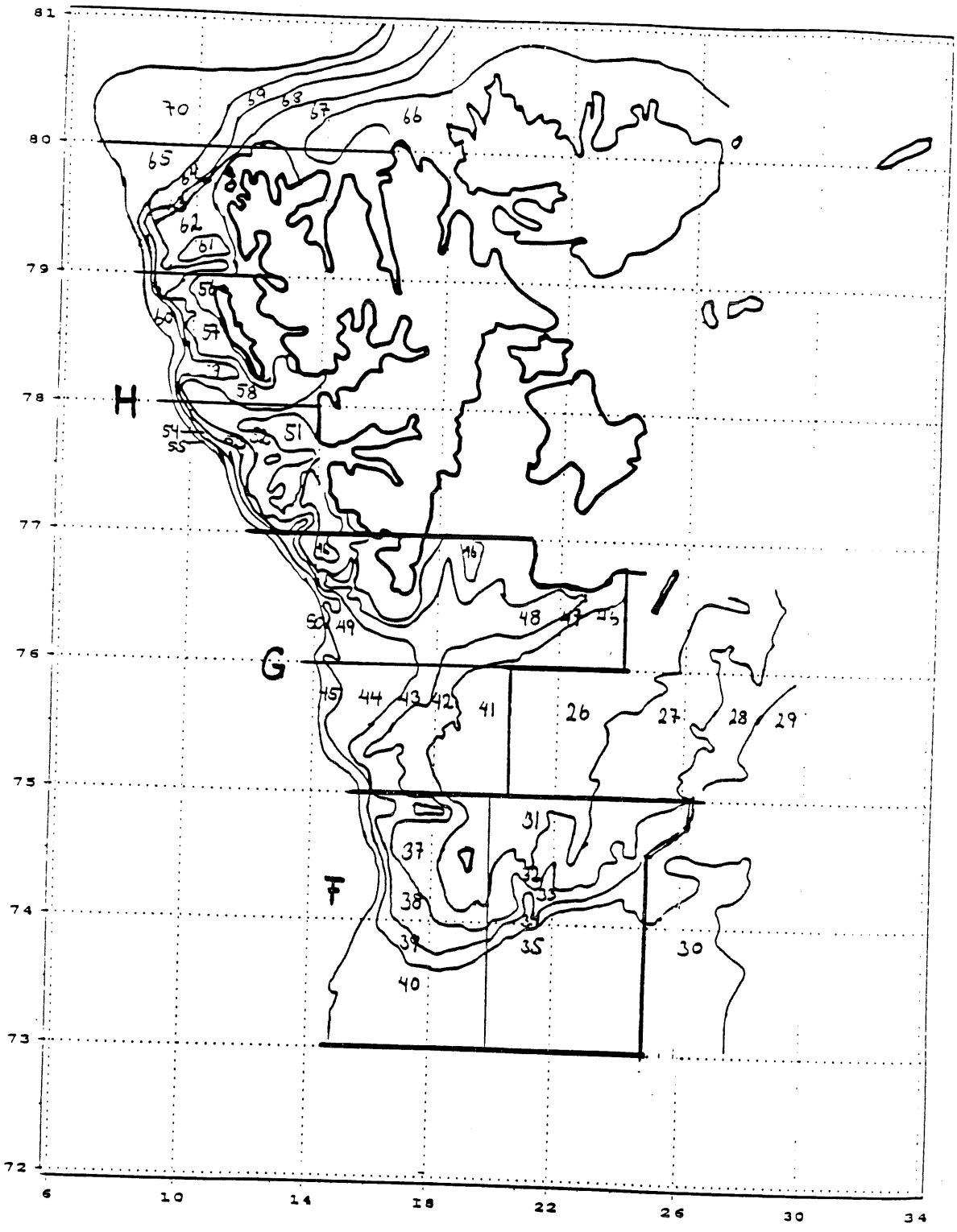

Figure 2. Sampling strata used in the Svalbard area for the shrimp surveys. Divisions into areas are given as letters F to H.

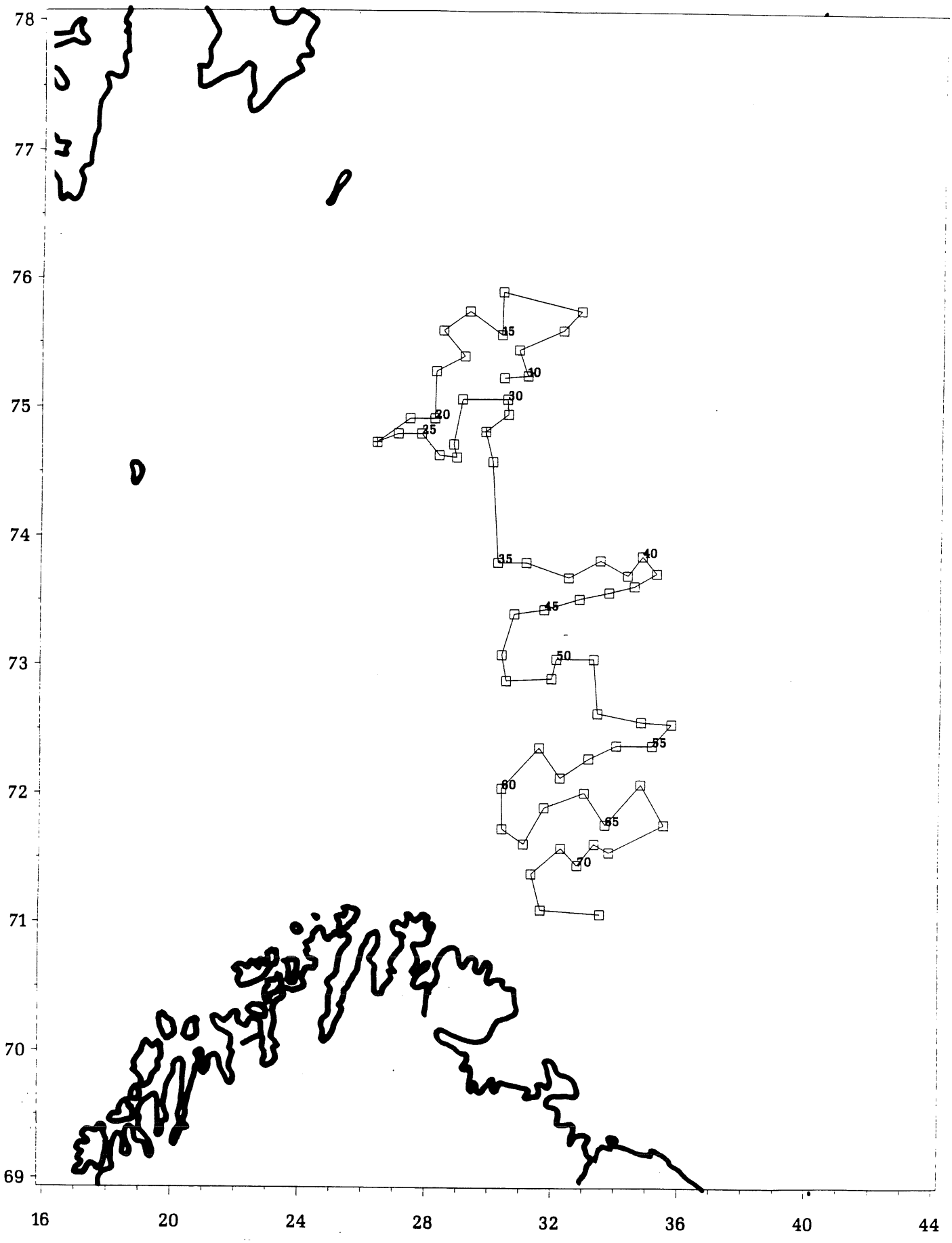

Figure 3. Stations and cruise route of the Russian vessel R/V "Kapitan Shaitanov" in the Barents Sea in May 1992.

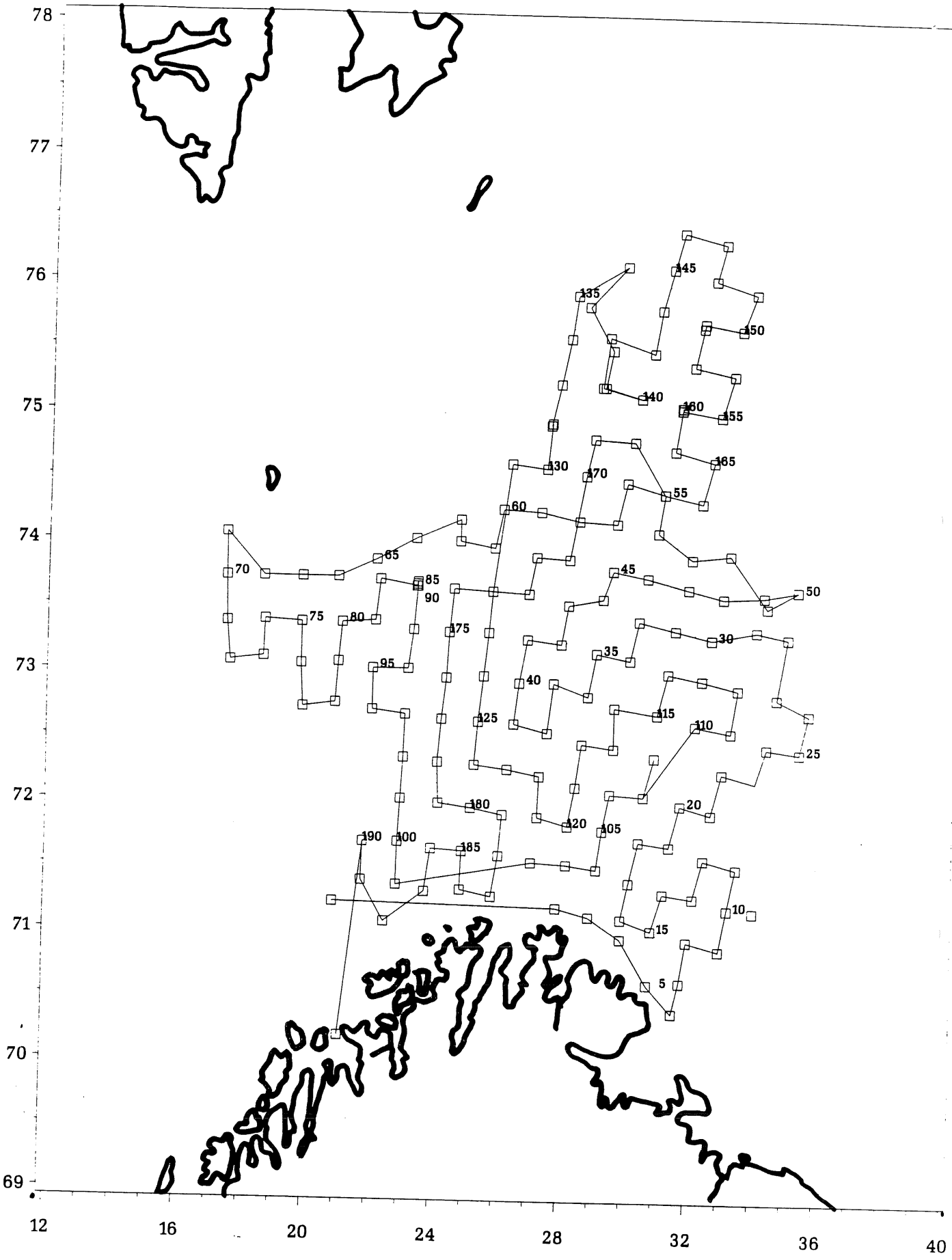

Figure 4. Stations and cruise route of the Norwegian vessel M/T "Gargia" in the Barents Sea in May 1992.

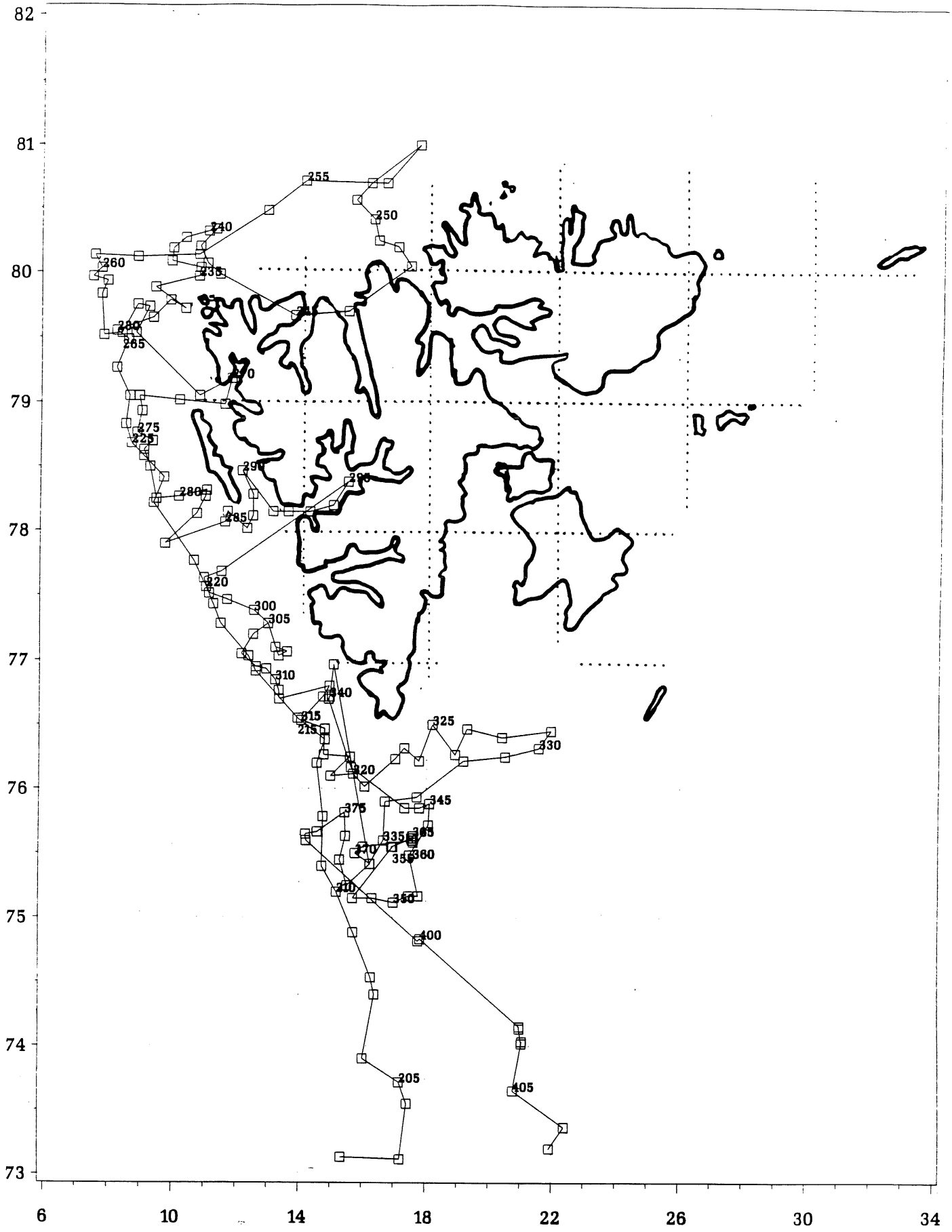

Figure 5. Stations and cruise route of the Norwegian vessel M/T "Gargia" In The Svalbard area in August and September 1992.

Table 1. Comparison of russian and norwegian sex determination of Pandalus borealis The discussion on age determination was held during the bilateral meeting in Tromsø 4-5 June 1992. This table of sex chategories and labels was created.

Sex stage	**Russian code**	**Norwegian code**
Male	Male	2
Transitional (intersex, Norway) - no headroe - with spines	Transitional	3
Female, first time spawner (intersex, Norway) - headroe - with spines	Female 1+, 1-3	4
Female spawned - outroe - no headroe - no spines	Female 2, 0	5a
Female, eggs spawned - outroe - headroe	Female 2, 1-3	5b
Female, larvae just hatched - setae, eggrests - no headroe	Female 3, 0	6a
Female, larvae just hatched - setae, eggrests - headroe	Female 3, 1-3	6b
Female resting stage	Female 0	7
Female second time spawner - Headroe - no spines	Female 1-, 1-3	8

Table 2. Results of the Russian survey in the Barents sea in May 1992.
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	Mean catch error, kg	Biomass thousand tonnes	SE of biomass	Abund-ance billion ind.	SE of abund-ance
1c	2017	5	9.2	2.9	4.0	1.3	0.7	0.3
2	1650	4	67.5	21.7	24.4	7.8	5.8	2.1
4	2300	4	110.8	18.2	55.7	9.2	13.6	2.4
6	2700	5	55.0	29.8	32.5	17.6	7.0	3.8
7	1850	5	287.8	48.4	116.5	19.6	28.1	5.0
10	1500	4	75.8	24.4	24.9	8.0	5.2	1.4
11	1325	6	109.0	36.2	31.6	10.5	7.8	2.7
12	1375	5	117.4	29.8	35.3	8.9	7.3	2.1
14	2550	4	47.3	29.9	26.4	16.7	5.6	3.6
15	2025	3	236.0	35.0	104.6	11.1	21.4	3.1
16	1575	4	201.0	72.7	69.3	25.0	15.4	5.6
17	1525	7	236.3	35.7	78.8	11.9	18.0	2.1
18	2500	6	239.0	31.5	130.7	17.2	32.2	3.7
Total	24892	62			734.8		168.1	

Table 3. Results of the Norwegian survey in the Barents sea in May 1992.
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	Abund-ance, billion ind.	SE of abundance
1	1232	3	18.6	1.2	0.1	2.2	0.3
2	1697	4	52.8	4.3	1.4	1.0	0.3
3	1926	6	18.9	1.9	0.4	0.3	0.1
4	1841	5	46.2	4.5	0.7	1.0	1.2
5	2282	6	15.9	1.9	0.6	0.4	0.1
6	2776	6	41.4	6.1	0.7	1.4	0.2
7	1953	5	85.5	8.8	1.5	2.0	0.3
8	2401	6	25.5	3.2	1.1	0.7	0.2
9	2988	3	57.6	9.1	2.4	1.8	0.4
10	1550	4	87.3	7.1	2.8	1.5	0.6
11	1364	5	32.7	2.4	1.2	0.6	0.3
12	1423	4	87.6	6.6	0.8	1.3	0.2
13	2608	8	70.5	9.7	2.0	2.1	6.4
14	2535	6	109.5	14.6	2.1	3.2	0.3
15	2039	7	77.4	8.3	1.6	1.8	0.4
16	1553	6	24.0	2.0	1.8	0.7	0.6
17	1535	11	89.1	7.2	0.9	2.5	0.3
18	2457	7	82.5	10.7	2.6	3.1	0.7
19	1299	5	6.3	0.4	0.2	0.1	0.0
20	1509	4	91.2	7.3	1.5	1.6	0.3
21	3270	12	37.2	6.4	0.9	1.2	0.2
22	3113	19	45.9	7.5	1.0	1.6	0.2
24	1558	4	39.9	3.3	0.8	1.3	0.4
Total	46909	146		134.5		31.5	

Table 4. Results of the Norwegian survey in the Svalbard area in September 1992. 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	Abund-ance, billion ind.	SE of abundance
33	1285	2	103.2	7.0	1.8	1.9	0.4
34	900	3	84.3	4.0	1.3	1.0	0.3
35	5260	26	52.8	14.7	1.7	3.1	0.4
39	871	8	13.2	0.6	0.2	0.2	0.1
40	3861	10	33.9	6.9	1.0	1.2	0.2
43	786	9	18.9	0.8	0.3	0.3	0.1
44	1217	10	45.3	2.9	0.5	0.5	0.1
45	357	2	21.9	0.4	0.2	0.1	0.1
47	2534	2	86.7	11.6	3.3	6.6	1.4
48	1883	21	73.8	7.3	2.4	2.5	1.1
49	611	7	35.1	1.1	0.3	0.2	0.1
50	246	5	63.3	0.8	0.4	0.2	0.1
52	1070	1	312.0	17.6	0.0	3.8	0.0
53	525	8	83.7	2.3	1.0	0.6	0.3
54	102	4	128.4	0.7	0.2	0.1	0.0
55	249	5	102.0	1.3	0.2	0.3	0.1
58	829	14	83.4	3.6	1.1	1.1	0.3
59	208	7	76.2	0.8	0.2	1.9	0.6
60	269	6	13.8	0.2	0.1	0.4	0.2
62	537	5	8.7	0.2	0.2	0.1	0.1
64	155	7	88.2	0.7	0.2	1.4	1.1
65	846	9	8.7	0.4	0.2	0.5	0.3
68	95	2	50.7	0.2	0.1	0.0	0.0
69	56	5	75.9	0.2	0.1	0.1	0.0
70	734	13	41.4	1.6	0.5	0.3	0.1
Total	25486	191		87.9		28.4	

Table 5. Biomass indices for shrimp from Russian surveys in the years 1984-1992 by main areas. (1000 tonn)

Main area	A East Finnmark	B Tiddly Bank	C - Thor Iversen bank	E Hopen	F Bear Island	G Storfjord Trench	H Spits-bergen	Total	Sum. A,B,C, E
Strata in area/Year	1 - 4	6 - 7	10 - 12	14 - 18, 24	19 - 22/ 31 - 40	41 - 50	51 - 70		
1984	38	137	99	254				528	
1985	14	45	74	255		6	46	440	
1986	9	19	44	140		42	127	381	
1987	16	17	59	107	45	36	27	307	
1988	14	31	39	49		22	29	184	
1989	70	128	57	132	6	60	25	478	
1990	90	137	119	259	14	110	30	759	
1991	90	94	104	541	9	70	27	935	829
1992	80	149	92	409					730
+% 92/91	-11	59	-12	-24					-12

Table 6. Biomass indices for shrimp from Norwegian surveys in the years 1982- 1992 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
Strata in area/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
1983	40	57	61	53	112	52	21	33	429
1984	40	51	64	60	141	66	20	29	471
1985	23	17	27	18	96	31	17	17	246
1986	10	7	13	25	57	34	10	10	166
1987	29	13	18	23	31	10	9	13	146
1988	26	18	18	36	32	24	13	14	181
1989	41	17	13	17	33	53	22	20	216
1990	31	13	25	42	58	43	27	23	262
1991	18	20	25	46	87	38	21	10	265
1992	12	15	16	24	46	33	32	30	208
+% 92/91	-33	-25	-36	-48	-47	-13	52	200	-22

Table 7. Deepwater shrimp landings (1000 ton) in the Barents Sea I, Svalbard Area II B and Norwegian Sea II A in 1983 - 1992.

		1983	1984	1985	1986	1987	1988	1989	1990	1991*	1992*
I	Barents Sea	63.4	60.2	40.9	13.8	14.6	22.4	35.6*	43.7*	35.8	34.0
II B	Svalbard Area	36.1	58.7	75.5	45.3	24.0	23.1	23.7*	34.6*	38.5	24.5
II A	Norwegian Sea	5.3	9.2	8.1	6.1	4.9	3.2	3.5*	2.7*	3.6	5.1

Source: ICES, Bulletin statistique des Peches maritimes. Norwegian Fisheries Directorate (Numbers for 1991 and 1992).
* Preliminary data.

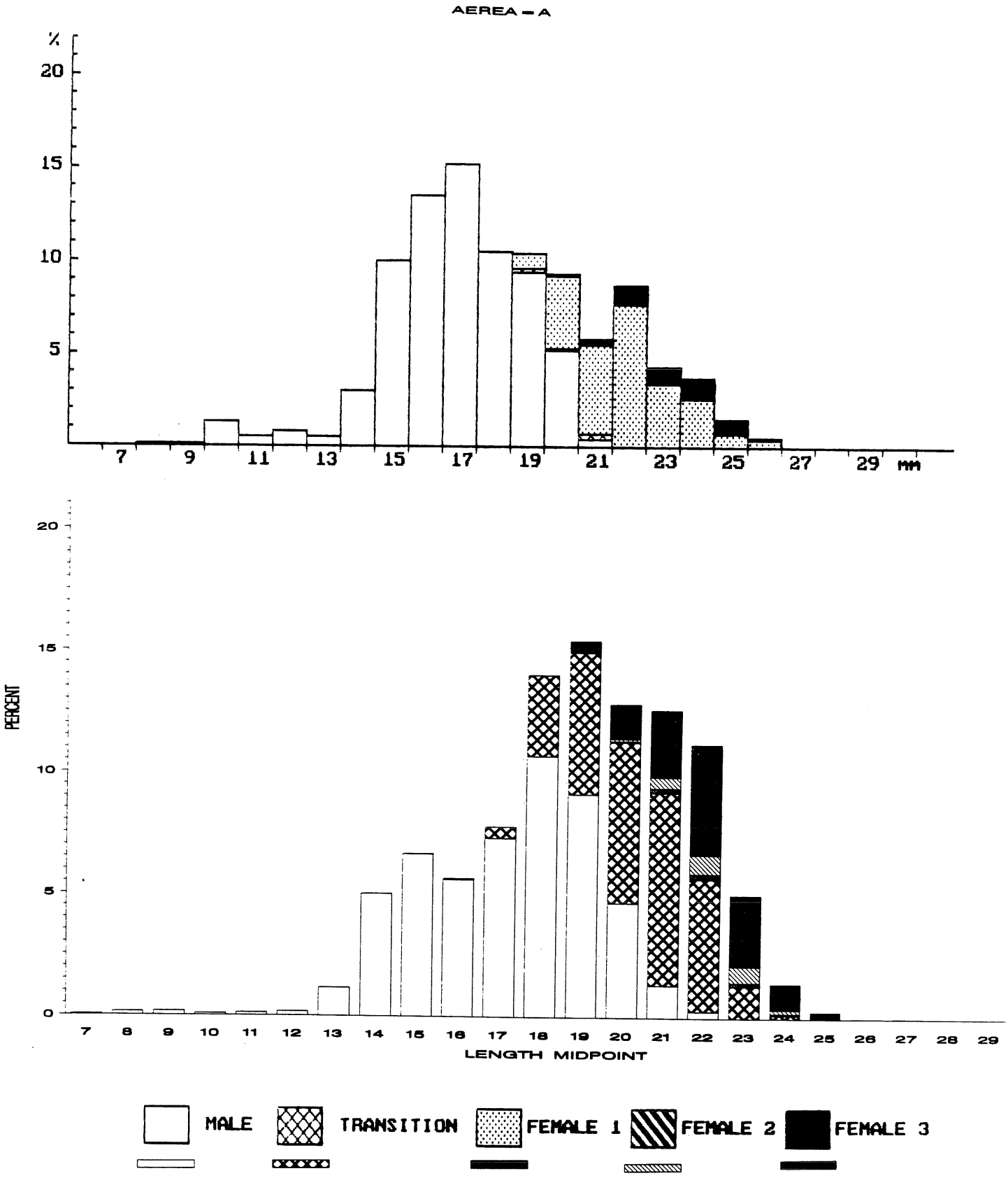

Figure 6a. Length distribution of shrimp from East Finnmark (area A) based on data from Russian (above) and Norwegian (below) surveys 1992. Columns are divided into sexual stages as given in the legend.

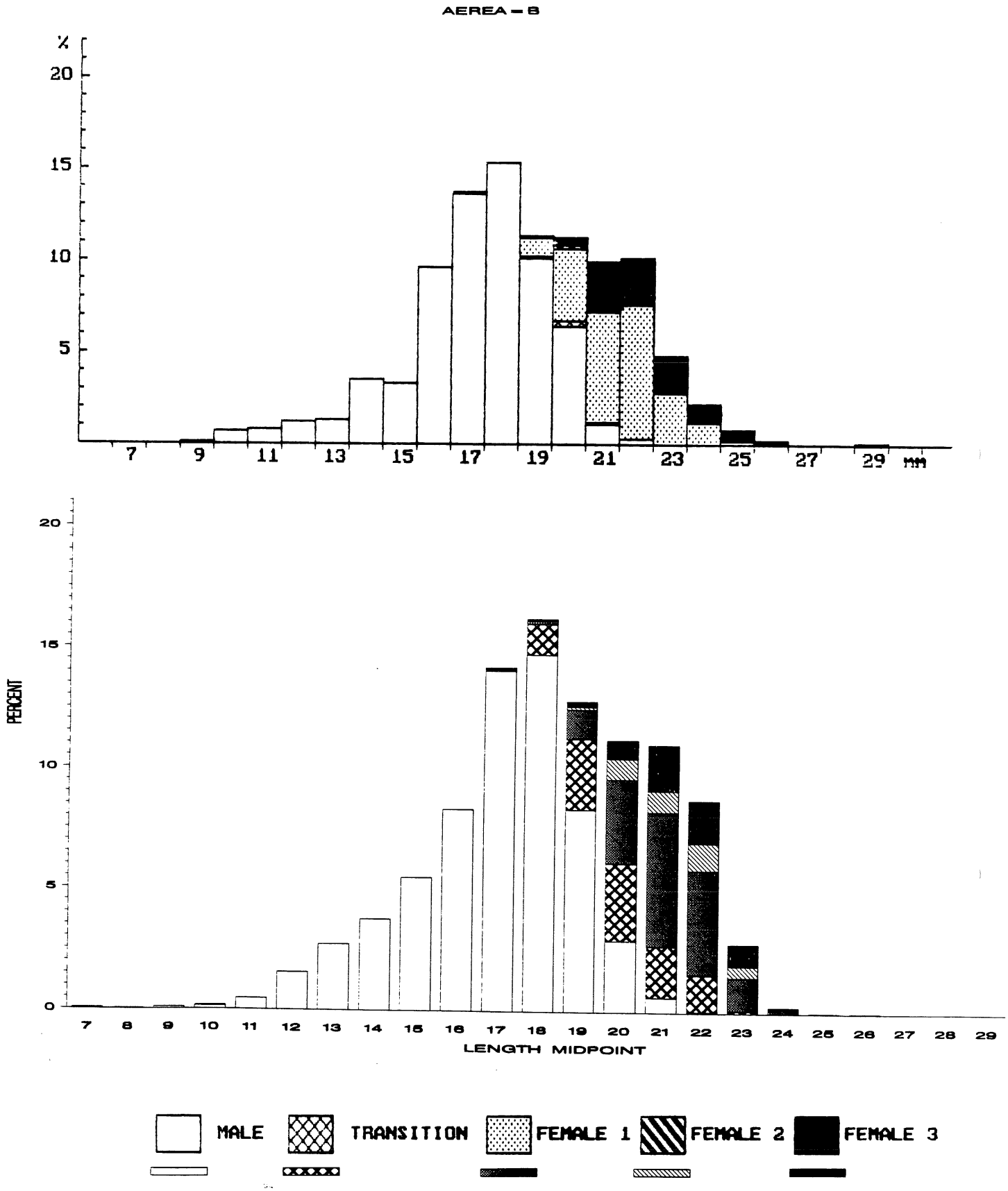

Figure 6b. Length distribution of shrimp from Tiddly Bank (area B) based on data from Russian (above) and Norwegian (below) surveys 1992. Columns are divided into sexual stages as given in the legend.

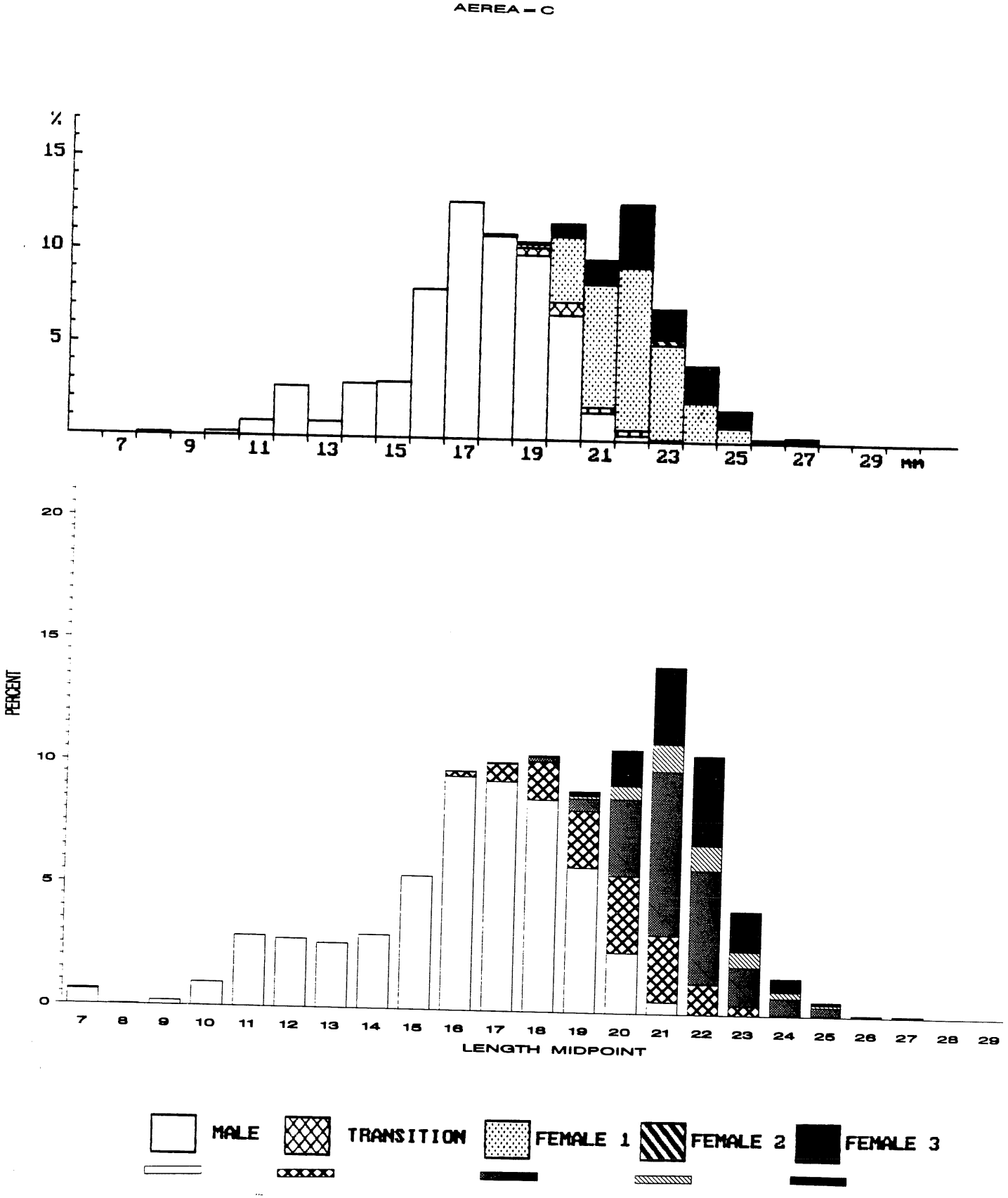

Figure 6c. Length distribution of shrimp from Thor Ivertsen Bank (area C) based on data from Russian (above) and Norwegian (below) surveys 1992. Columns are divided into sexual stages as given in the legend.

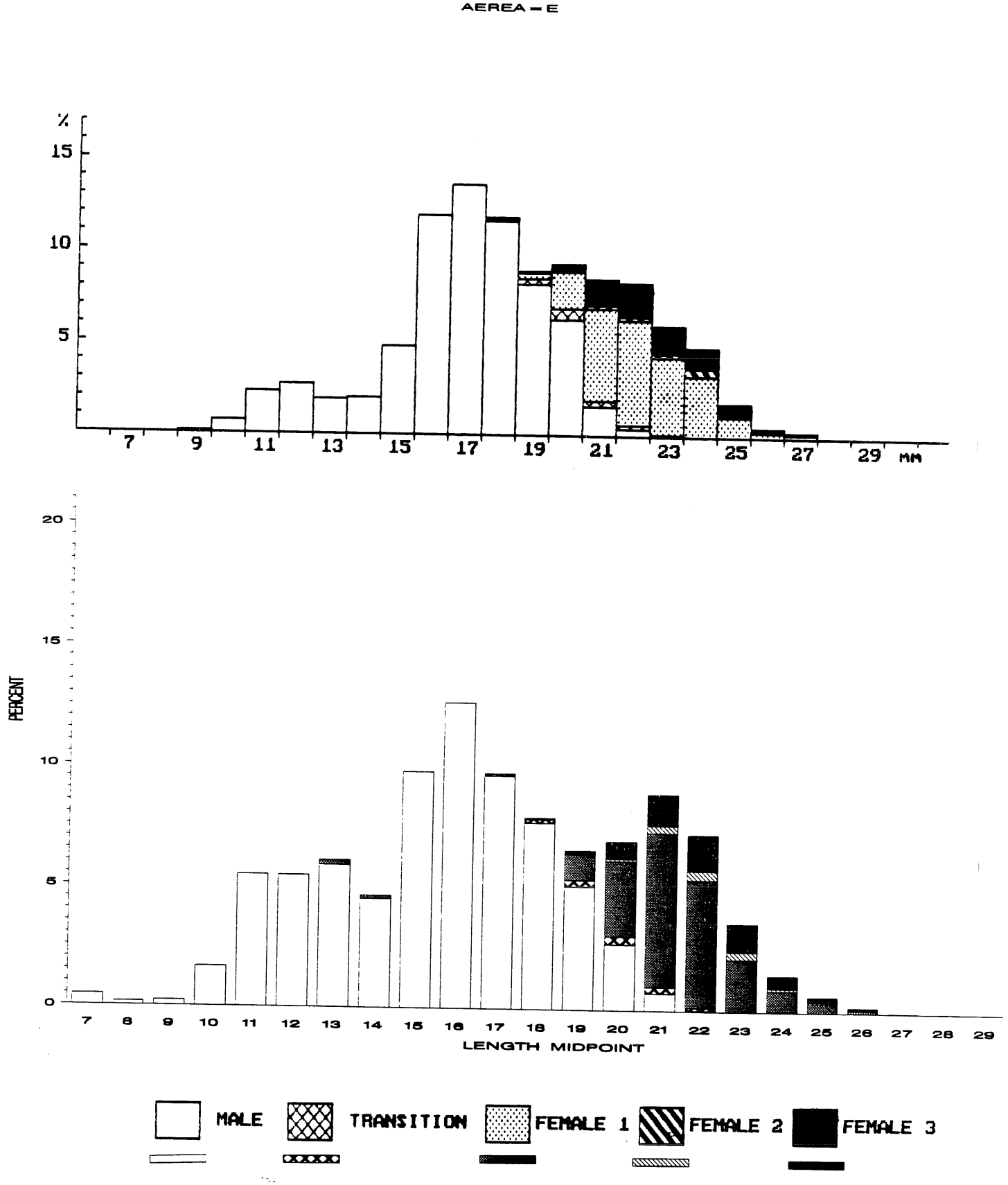

Figure 6d. Length distribution of shrimp from Hopen (area E) based on data from Russian (above) and Norwegian (below) surveys 1992. Columns are divided into sexual stages as given in the legend.

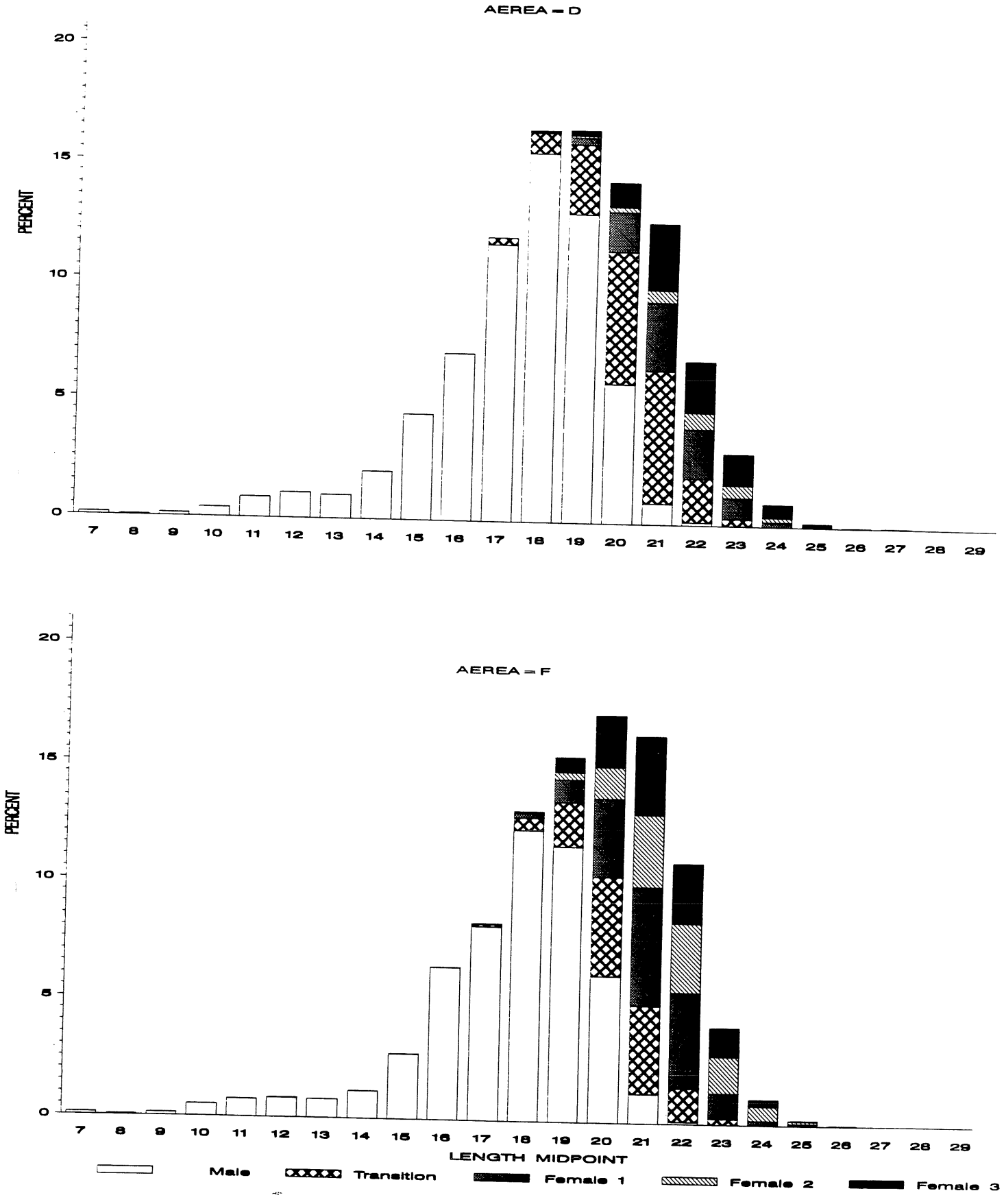

Figure 6e. Length distribution of shrimp from Bear Island Trench (area D) and Bear Island (area F) based on data from the Norwegian survey 1992. Columns are divided into sexual stages as given in the legend.

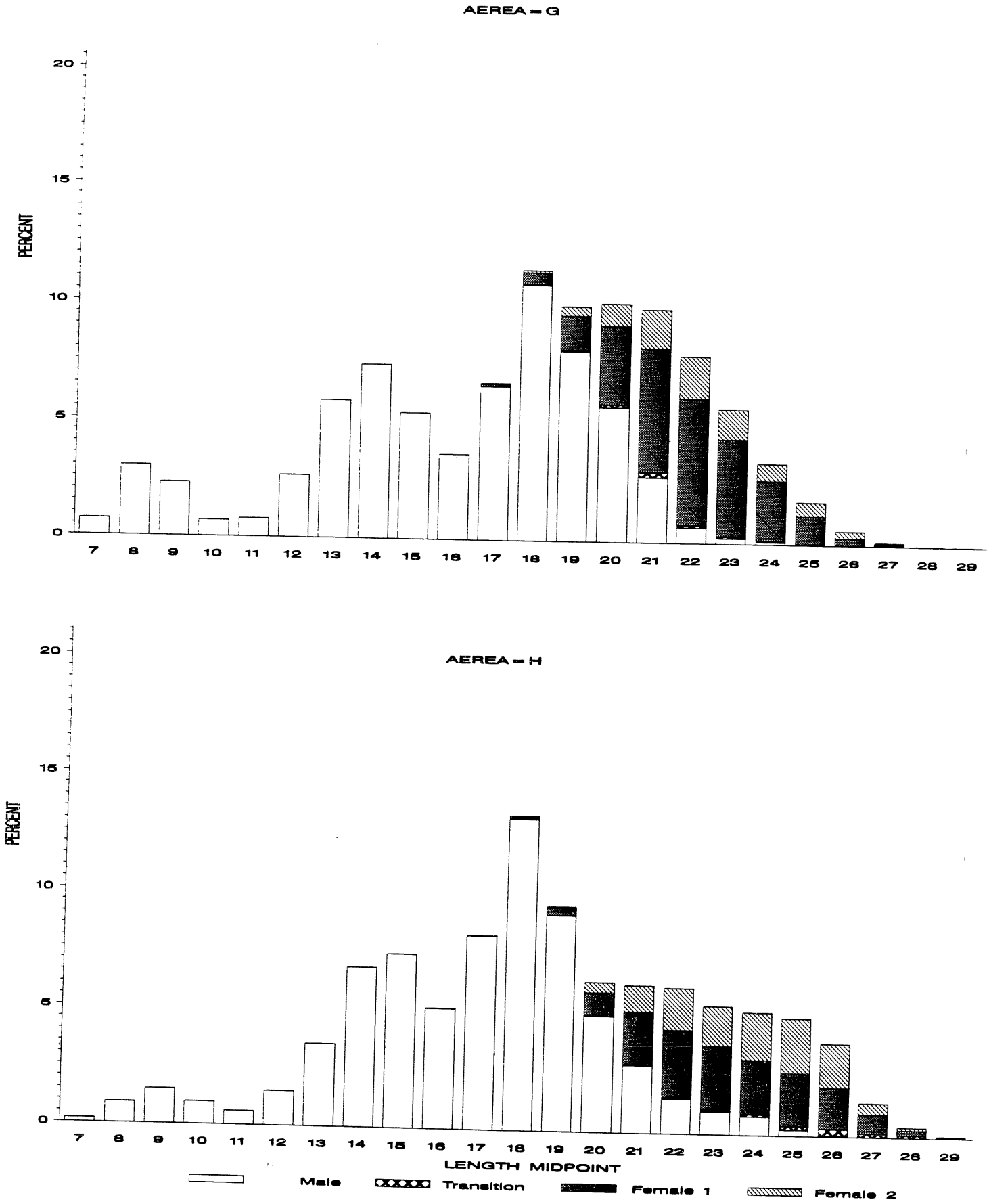

Figure 6f. Length distribution of shrimp from Storfjord Trench (area G) and Spitsbergen (area H) based on data from the Norwegian survey 1992. Columns are divided into sexual stages as given in the legend.