

RESULTS OF NORWEGIAN AND RUSSIAN INVESTIGATIONS OF SHRIMP
(*Pandalus borealis*) IN THE BARENTS SEA AND SVALBARD AREA IN 1991.

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 1991 are presented in this paper. The survey results are presented by nation but the discussion is given combined.

The results show that the data from both countries show similar trends. They indicate that shrimp biomass in the area of the joint research activities has increased, especially in the areas north of 74°N and east of 25°E. The norwegian data indicate that the shrimp biomass in the western Barents sea is at the level of last year. A slight decrease in the biomass is observed in the southernmost areas of the Barents sea.

A decrease in biomass is observed in the areas west of 25°E and north of 73°N, that is in the Svalbard region.

INTRODUCTION.

The shrimp surveys in the Barents sea and the Svalbard area have been undertaken since 1982 by Norwegian vessels and since 1984 by Soviet vessels. The results have not been used as basis for regulating the fisheries. However, both Russia and Norway feel that a stronger cooperation should take place in evaluating the stocks of shrimp in the northern areas in order to improve the use of the results, preferably into a basis for fisheries regulation. Joint research during the surveys and joint meeting to discuss the results have taken place frequently and it was felt natural to make this years presentation of the results

to ICES as a joint paper.

MATERIAL AND METHODS.

The areas surveyed and the stratification used is given in figs 1 and 2. Very much the same stratification and numbering of the strata have been used by both countries with few, minor differences. However, both the Svalbard and the Barents sea strata have earlier been numbered from 1. This year we have introduced a new numbering of the Svalbard strata and the strata shallower than 200m depth have also been included to give compatibility to the demersal fish surveys.

The Norwegian sampling trawl used is the standard sampling trawl of all bottom trawl surveys. It is a modified shrimp trawl with "rockhopper" ground gear. The "sweep with" is set to 11.7m for shrimp surveys resulting in a swept area of a 3 nm haul of 0.01895sq.nm.

The Russian trawl used is the standard trawl of all Russian surveys for shrimp. The "sweep with" is set to 15.5m and the coefficient of trawl efficiency is set to 0.182 resulting in a swept area of a 3nm haul of 0.00457sq.nm.

Thus, the indices of biomass and abundance given by the two countries are not comparable other than by trend.

The Russian survey was conducted in the Barents sea from 30 April to 15 May by the stern trawler R/V "Artemida". The survey in the Svalbard area was conducted from 26 June to 24 July by the ship R/V "Artemida". The method of conducting the survey and making the calculations are described by Teigsmark and Øynes, 1982, Berenboim *et al.*, 1987.

The Norwegian survey was conducted in the Barents sea from 29 April to 13 June by R/V "Michael Sars" and in the Svalbard area from 5 August to 15 September by the hired commercial stern trawler M/Tr "Anny Kræmer". The trawl station and the survey tracks are given in figs 3 and 4. Methods are described by Teigsmark and Øynes, 1982.

RESULTS

The Russian survey in the Barents sea covered the strata 1c, 2,4,6,7,10,11,12,14,15,16,17 and 18 with 87 trawlstations. The Norwegian survey covered all strata except 1c with 216 trawlstations of which 178 are included in the calculations.

The Russian survey in the Svalbard area covered strata 38 (2), 39 (1), 40 (16), 43 (4), 44 (3), 45 (17), 48 (6,7), 49 (5), 50 (18), 53 (9), 54 (8), 55 (19), 58 (11), 59 (10), 60 (20) with 88 trawlstations. The numbers in parenthesis refer to the old stratasystem used by Norwegian and Russian surveys (Hysten *et al.*, 1989). The Norwegian survey covered all the strata with 231 hauls of which 117 are included in the calculations, leaving out the most shallow strata where no shrimp was found. In tables 1, 2, 3 and 4 are shown the results of the Russian and the Norwegian surveys. It should be noted that the area of the strata may be slightly different in the Russian and Norwegian surveys. This is caused by calculating the area from maps with different depth contours and also sometimes using different north - south boundaries.

It is seen that the average catch in kg/3nm are somewhat larger for the russian trawl compared to the norwegian trawl. Earlier trawling experiments have shown that on low densities of shrimp the two trawls have almost the same catch efficiency, but on higher densities the russian trawl is catching by far more than the norwegian, giving an average ratio of 1.53 (Mukhin and Sheveleva, 1991)

In tables 5 and 6 the results are combined into larger areas reflecting main fishing grounds. Here is also given the abundance in numbers divided into sexual maturity stages. The groups used are "males" - including also juveniles, "intersex" - which is the sexual transition stage and also in this case including the females in a resting stage, "females with developing ovocytes" (with head-roe) - also including the specimens developing from intersex and, last, "females with eggs on pleopods and just after hatching" (with out-roe or setae on pleopods).

In fig 5 are given the length distributions of shrimp caught in the different areas. They also show the frequencies divided into the sexual maturity stages.

In tables 7 and 8 are given the biomass in each area for the years that the surveys have been carried out together with the percentage change from 1990 to 1991.

DISCUSSION

A general trend of increase in the biomass from 1990 to 1991 is observed. From the experiments showing the lower catch efficiency of the Norwegian trawl on high densities it may be stated that the Norwegian surveys do not reflect the increase to the same degree as the russian surveys. This is seen from tables 7 and 8 where the russian biomass estimates in years and areas of low densities are only slightly higher than the norwegian estimates, whereas in years and areas of high densities the russian estimates are by far higher than the norwegian estimates.

However, both Norwegian and Russian surveys indicate a substantial increase in the Hopen area and an increase in the Tiddly bank area. A fairly stable situation is found in the areas East Finnmark and Thor Iversen bank, although a decline may be seen in East Finnmark from the Norwegian survey. In the area of Bear Island trench, east, the Norwegian survey indicate a slight increase. Both Norwegian and Russian surveys indicate a decline in biomass in the areas Bear Island, Storfjord Trench and Spitsbergen.

The percentage of "males" are high in the Hopen area, above 70%, and is found to be between 50 and 60% in the other areas, except for the Russian result in Spitsbergen (36%). The proportion of "females with headroe" is high in Spitsbergen and Storfjord trench, above 40% and fairly high in Bear Island are, apr. 33%.

There is, however a slight discrepancy between the norwegian and russian results for the other areas. The Russian surveys observe higher percentages of "intersex" and "females with out-roe or newly hatched" than the Norwegian surveys. Despite the discrepancies, the situation may be indicated as fairly equal for the areas of East Finnmark, Tiddly bank and Thor Iversen bank and the proportion of "intersex", "females with headroe" and "females with out-roe and after hatching" may be said to be equal, between 10 and 20% each in these areas. The differences may be allocated to different evaluation of shrimps

with head-roes when they are first time spawners and when they also have out-roes or eggs on pleopods.

The numbers of females have increased from 1990 to 1991 in the areas of Tiddly bank, Hopen, Bear Island and Storfjord trench. The number of males have increased in the areas of Tiddly bank, Thor Iversen bank, Bear Island trench, east and Hopen. (Mukhin and Sheveleva, 1991 and internal Norwegian report)

From fig 5 it is seen that the 4 year old individuals, the 1987 yearclass being from 21 to 23 mm in the west and slightly less in the east, are dominating in biomass and that the 1986 yearclasses, which are the largest individuals, still contributes substantially to the stock.

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

Stratum	Area, sq.nm.	Number of hauls	Mean catch, kg/3nm	SE of mean	Biomass thousand tonnes	SE of biomass	Abundance, billion ind.	SE of abundance
1c	2017	6	134.2	17.9	59.2	34.3	13.7	8.5
2	1650	6	94.7	28.6	34.2	10.3	7.0	1.6
4	2300	6	110.2	22.4	55.4	11.3	11.5	2.2
6	2700	7	61.1	10.5	47.9	6.2	10.2	1.3
7	1650	9	114.1	14.2	46.2	5.7	9.4	1.1
10	1500	7	106.1	18.3	34.8	6.0	7.1	1.3
11	1325	6	100.5	28.0	29.1	8.1	5.5	1.6
12	1375	6	132.5	16.9	39.9	5.1	8.6	1.2
14	2550	8	251.4	47.5	140.3	26.5	29.1	5.3
15	2025	8	190.4	17.8	84.4	7.9	16.8	1.4
16	1575	5	337.4	29.7	116.3	10.2	27.6	3.5
17	1525	7	270.3	30.6	90.2	10.2	19.6	2.3
18	2500	6	200.3	33.8	109.6	18.5	37.1	4.6

Table 2. Results of the Norwegian survey in the Barents sea. 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	Abundance, billion ind.	SE of abundance
1	1232	6	34.8	2.3	0.7	0.4	0.1
2	1697	7	30.6	2.7	0.8	0.7	0.2
3	1926	8	75.9	7.7	2.7	1.7	0.6
4	1841	7	59.4	5.8	1.6	1.3	0.3
5	2282	7	25.8	3.1	1.1	0.7	0.3
6	2776	9	57.0	8.4	2.1	1.8	0.5
7	1953	8	111.3	11.5	3.1	2.7	0.8
8	2401	9	53.3	6.9	1.8	1.5	0.4
9	2988	3	176.4	27.8	4.7	6.3	11.9
10	1550	5	102.3	8.4	1.3	1.8	0.3
11	1364	8	79.5	5.7	1.7	1.2	0.4
12	1423	5	149.4	11.2	2.7	2.4	0.6
13	2608	14	58.0	7.8	2.1	1.8	0.5
14	2535	8	153.3	20.5	5.1	4.3	1.1
15	2939	10	131.7	14.2	3.5	2.9	0.8
16	1553	5	153.6	12.6	1.9	3.2	0.6
17	1535	17	160.5	13.0	2.8	2.9	0.7
18	2457	7	88.5	11.5	3.3	3.6	1.1
19	1299	5	35.0	2.4	1.4	0.5	0.3
20	1509	5	123.6	9.8	2.4	2.1	0.5
21	3270	13	55.5	9.6	2.5	2.0	0.5
22	3113	11	62.4	10.2	1.8	2.3	0.4
24	1558	1	184.8	15.2		4.7	

Table 3. Results of the Russian survey in the Svalbard area. Area of stratum, number of stations and calculation of results for each stratum covered.

Stratum	Area, sq.nm.	Number of hauls	Mean catch, kg/3nm	SE of mean	Biomass thousand tonnes	SE of biomass	Abundance, billion ind.	SE of abundance
38	842	5	11.1	11.1	2.1	1.1	0.6	0.6
39	284	3	145.3	41.9	9.0	2.6	2.3	0.6
40	200	4	7.3	3.1	0.3	0.1	0.1	0.02
43	486	5	13.4	11.3	1.4	1.2	0.3	0.3
44	1189	10	81.2	16.0	21.1	4.2	3.5	0.7
45	357	6	7.2	2.6	0.6	0.2	0.1	0.03
48.*	353	3	1.3	1.3	0.1	0.1	0.02	0.02
48.*	1530	9	83.4	40.8	27.9	13.7	5.4	2.6
49	611	7	100.4	35.2	13.4	4.7	2.2	0.7
50	246	5	63.2	26.2	3.4	1.4	0.7	0.2
53	539	4	39.3	39.3	4.6	4.6	0.8	0.8
54	109	4	92.0	68.5	2.2	1.6	0.4	0.3
55	249	7	70.7	19.1	3.8	1.0	0.7	0.2
58	815	5	60.4	40.1	10.8	7.1	1.4	1.0
59	201	5	37.6	23.0	1.6	1.0	0.3	0.2
60	269	6	69.7	29.6	4.1	1.7	0.6	0.3

* The old strata 6 and 7 are combined into new strata 48 but the results in the table are given separately.

Table 4. Results of the Norwegian survey in the Svalbard area. 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	Abundance, billion ind.	SE of abundance
33	1285	4	114.9	7.8	3.5	1.8	0.8
34	900	3	106.5	4.6	1.3	0.9	0.2
35	5260	9	53.1	14.7	1.9	3.0	0.4
39	871	5	50.7	2.3	0.9	0.5	0.2
40	3861	7	41.4	8.4	1.8	1.6	0.4
43	786	6	8.4	0.3	0.1	0.1	0.04
44	1217	6	56.1	3.6	0.9	0.5	0.1
45	357	2	170.4	3.2	0.3	0.5	0.1
47	2534	8	1.8	0.3	0.1	0.1	0.1
48	1883	9	73.8	7.3	4.0	1.4	0.9
49	611	8	93.6	3.0	0.6	0.5	0.1
50	246	2	243	3.2	0.5	0.6	0.1
53	525	6	42.6	1.2	0.5	0.2	0.1
54	102	3	13.5	0.1	0.03	0.01	-
55	249	3	153.2	2.0	0.3	0.3	0.1
58	829	6	48.0	2.1	1.0	0.3	0.2
59	208	4	8.7	0.1	-	0.01	-
60	269	5	0.3	0	-	0	-
64	155	3	77.1	0.6	0.5	0.07	0.05
65	846	8	25.8	1.2	0.9	0.1	0.1
68	95	2	154.2	0.7	0.5	0.1	0.1
69	56	2	70.2	0.2	0.1	0.02	0.01
70	734	6	46.5	1.8	0.6	0.2	0.1

Table 5 Results from Russian surveys presented by main areas. Biomass, abundance - total and by stages.

Main areas	Strata in area	Biomass thousand tonnes	Abundance, billions	Males	%	Intersex Resting females	%	Females, head-roe	%	Females, out-roe/hatched	%
A - East Finnmark	2, 4	89.6	18.6	10.42	56	2.60	14	2.42	13	3.16	17
B - Tiddly bank	1c, 6, 7	153.4	33.3	17.98	54	7.33	22	4.66	14	3.33	10
C - Thor Iversen bank	10 - 12	103.9	21.2	11.66	55	4.03	19	1.70	8	3.60	17
D - Bear Isl. Trench, east	5, 8, 9, 13	-	-	-	-	-	-	-	-	-	-
E - Hopen	14 - 18, 24	540.7	130.3	96.42	74	13.03	10	13.03	10	7.82	6
F - Bear Island	(19-22) 31 - 40	9.3	2.4	1.44	60	0.17	7	0.77	32	0.02	1
G - Storfjord Trench	41 - 50	70.0	12.8	6.91	54	0.51	4	5.38	42	0.13	1
H - Spitsbergen	51 - 70	27.1	4.2	2.18	52	0.13	3	1.89	45	0.04	1
Total		994.00	222.80	147.01		27.80		29.85		18.10	

Table 6 Results from Norwegian surveys presented by main areas. Biomass, abundance - total and by stages.

Main areas	Strata in area	Biomass thousand tonnes	Abundance, billions	Males	%	Intersex Resting females	%	Females, head-roe	%	Females, out-roe/hatched	%
A - East Finnmark	1 - 4	18.48	4.04	2.34	58	1.17	29	0.40	10	0.12	3
B - Tiddly bank	6 - 7	19.82	4.52	2.80	62	0.14	3	1.36	30	0.18	4
C - Thor Iversen bank	10 - 12	25.32	5.45	3.32	61	0.16	3	1.53	28	0.44	8
D - Bear Isl. Trench, east	5, 8, 9, 13	45.78	10.28	6.78	66	1.34	13,	1.34	13	0.72	7
E - Hopen	14 - 18, 24	86.90	21.66	15.16	70	0.43	2	4.77	22	1.30	6
F - Bear Island	(19-22) 31 - 40	37.91	7.93	4.84	61	0.08	1	2.70	34	0.32	4
G - Storfjord Trench	41 - 50	20.93	3.80	1.98	52	0.04	1	1.71	45	0.08	2
H - Spitsbergen	51 - 70	10.04	1.32	0.48	36	0.03	2	0.69	52	0.12	9
Total		265.18	59.00	37.70		3.39		14.50		3.28	

Table 7 Biomass indices for shrimp from Russian surveys in the years 1984 - 1991 by main areas.

Main areas	A East Finnmark	B Tiddly Bank	C - Thor Iversen bank	D - Bear Isl. Trench, east	E Hopen	F Bear Island	G Storfjord Trench	H Spitsbergen	Total
Strata in area/ Year	2,4	1c, 6, 7	10 - 12	5, 8, 9, 13	14 - 18	19-22 / 31 - 40	41 - 50	51 - 70	
1984	38	137	99	-	254				528.0
1985	14	45	74	-	255		6	46	440.0
1986	9	19	44	-	140		42	127	381.0
1987	16	17	59	-	107	45	36	27	307.0
1988	14	31	39	-	49		22	29	184.0
1989	70	128	57	-	132	6	60	25	478.0
1990	90	137	119	-	259	14	110	30	759.0
1991	90	153	104	-	541	9	70	27	994.0
+% 91/90	0.0	+11.7	-12.6	-	+108.9	-35.7	-36.4	-10.0	+31.0

Table 8 Biomass indices for shrimp from Norwegian surveys in the years 1982 - 1991 by main areas.

Main areas	A East Finnmark	B Tiddly Bank	C - Thor Iversen bank	D - Bear Isl. Trench, east	E Hopen	F Bear Island	G Storfjord Trench	H Spitsbergen	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	327.0
1983	40	57	61	53	112	52	21	33	429.0
1984	40	51	64	60	141	66	20	29	471.0
1985	23	17	27	18	96	31	17	17	246.0
1986	10	7	13	25	57	34	10	10	166.0
1987	29	13	18	23	31	10	9	13	146.0
1988	26	18	18	36	32	24	13	14	181.0
1989	41	17	13	17	33	53	22	20	216.0
1990	31	13	25	42	58	43	27	23	262.0
1991	18	20	25	46	87	38	21	10	265.0
+% 91/90	-41.9	+53.9	0.0	+9.5	+50.0	-11.6	-22.2	-56.5	+1.2

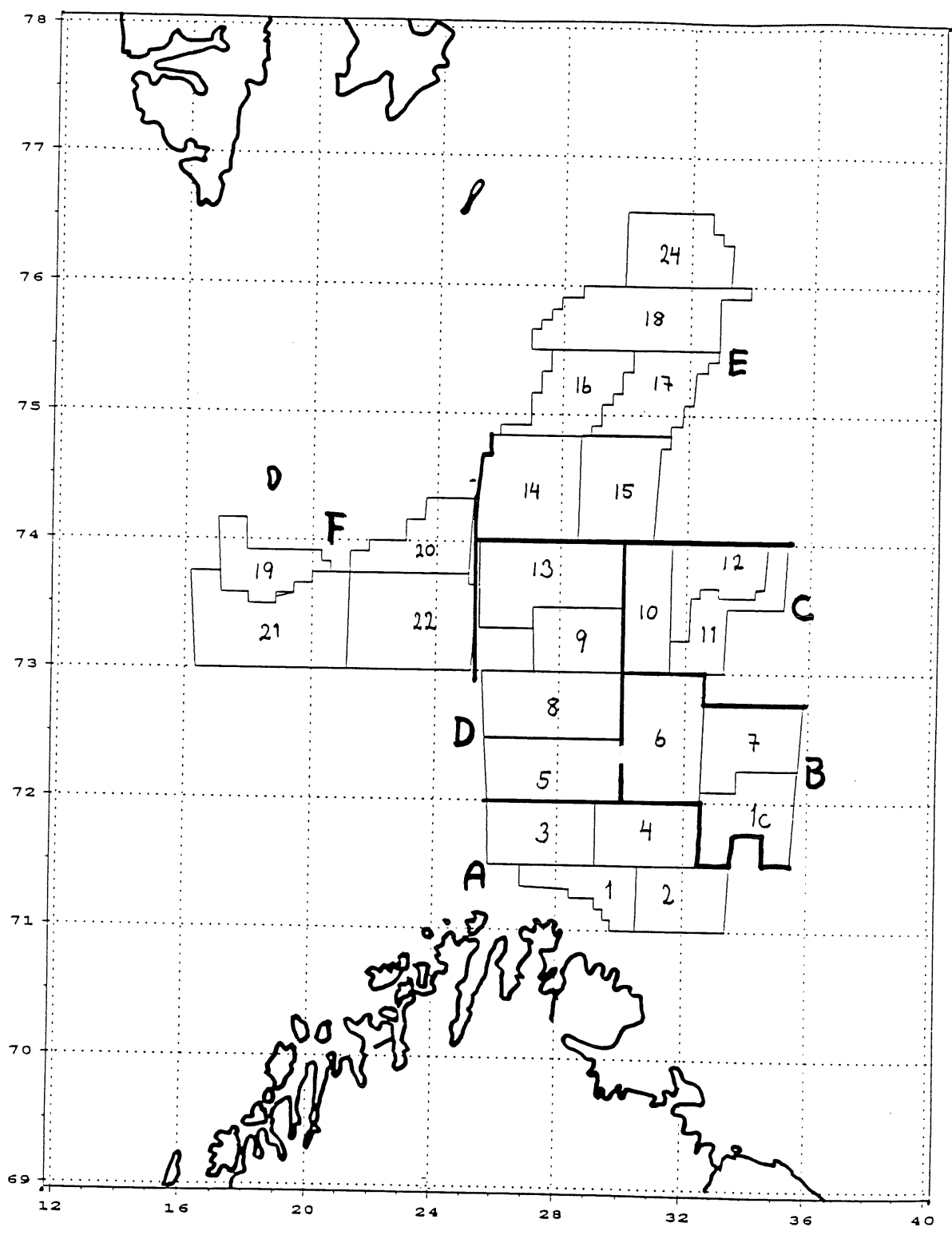


Figure 1. Sampling strata used in the Barents Sea for the shrimp surveys. Divisions into main areas are given as letters A to F.

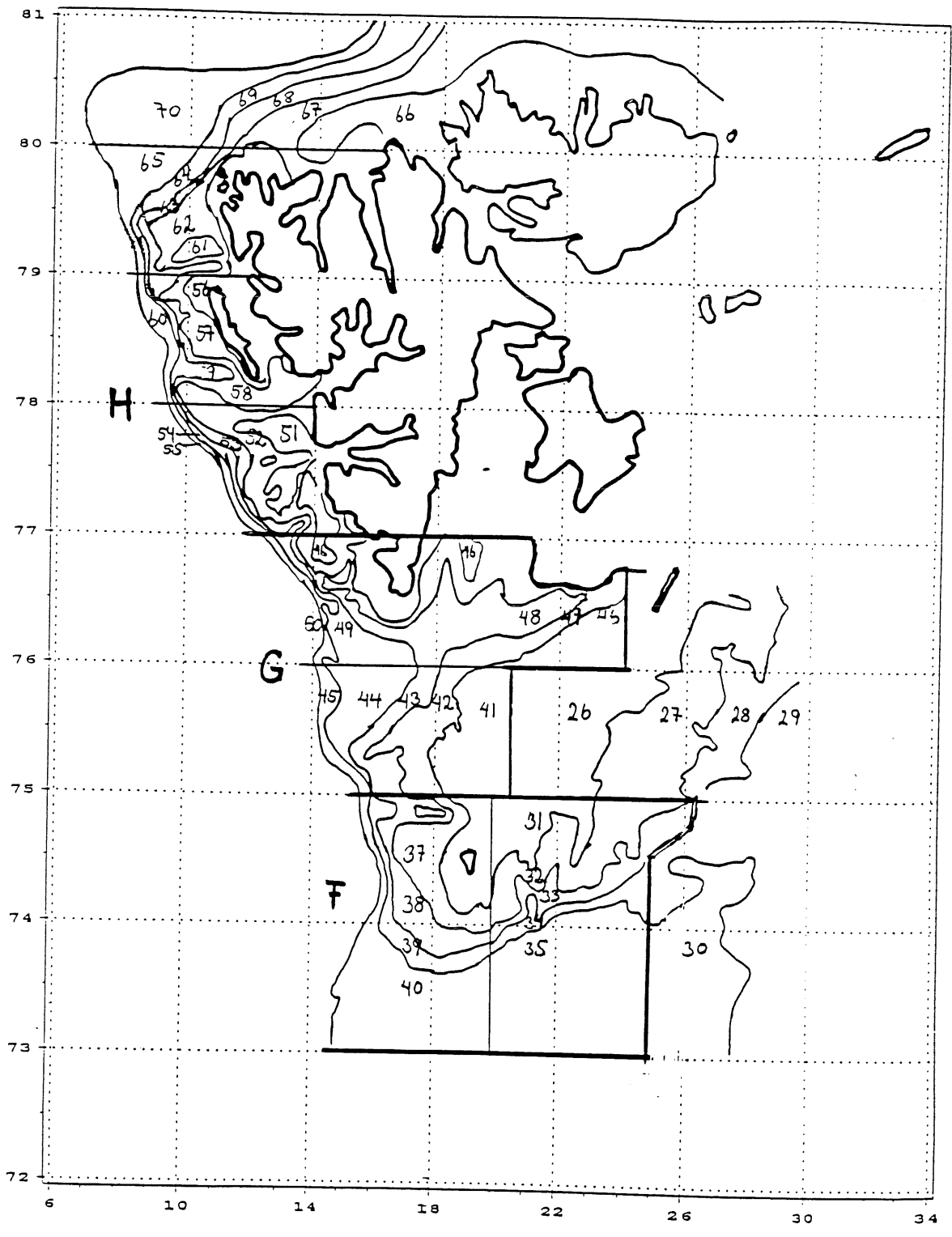


Figure 2. Sampling strata used in the Svalbard area for the shrimp surveys. Divisions into main areas are given as letters F to H.

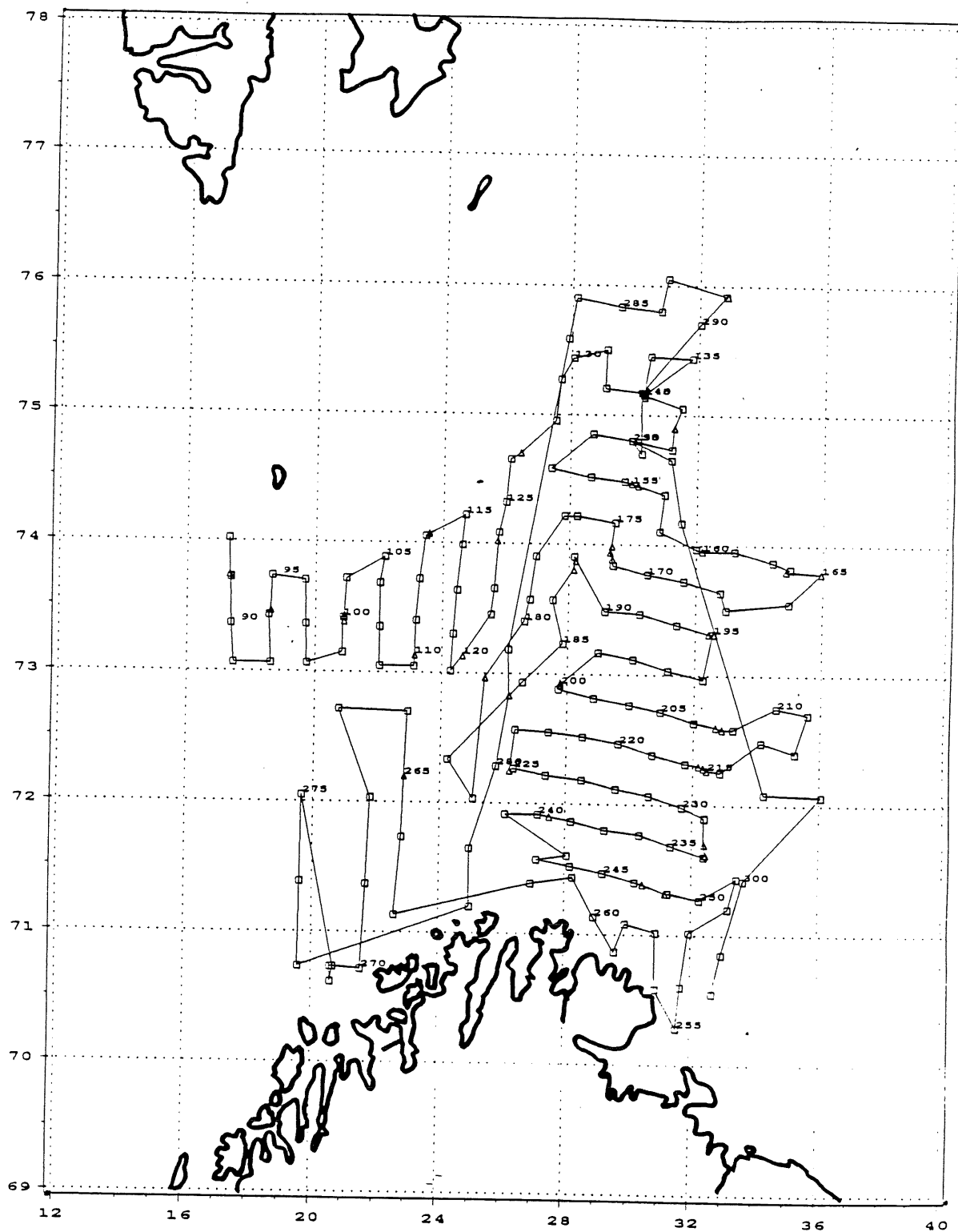


Figure 3. Trawlstations and course tracks for Norwegian survey in the Barents Sea with R/S "Michael Sars", May - June 1991.

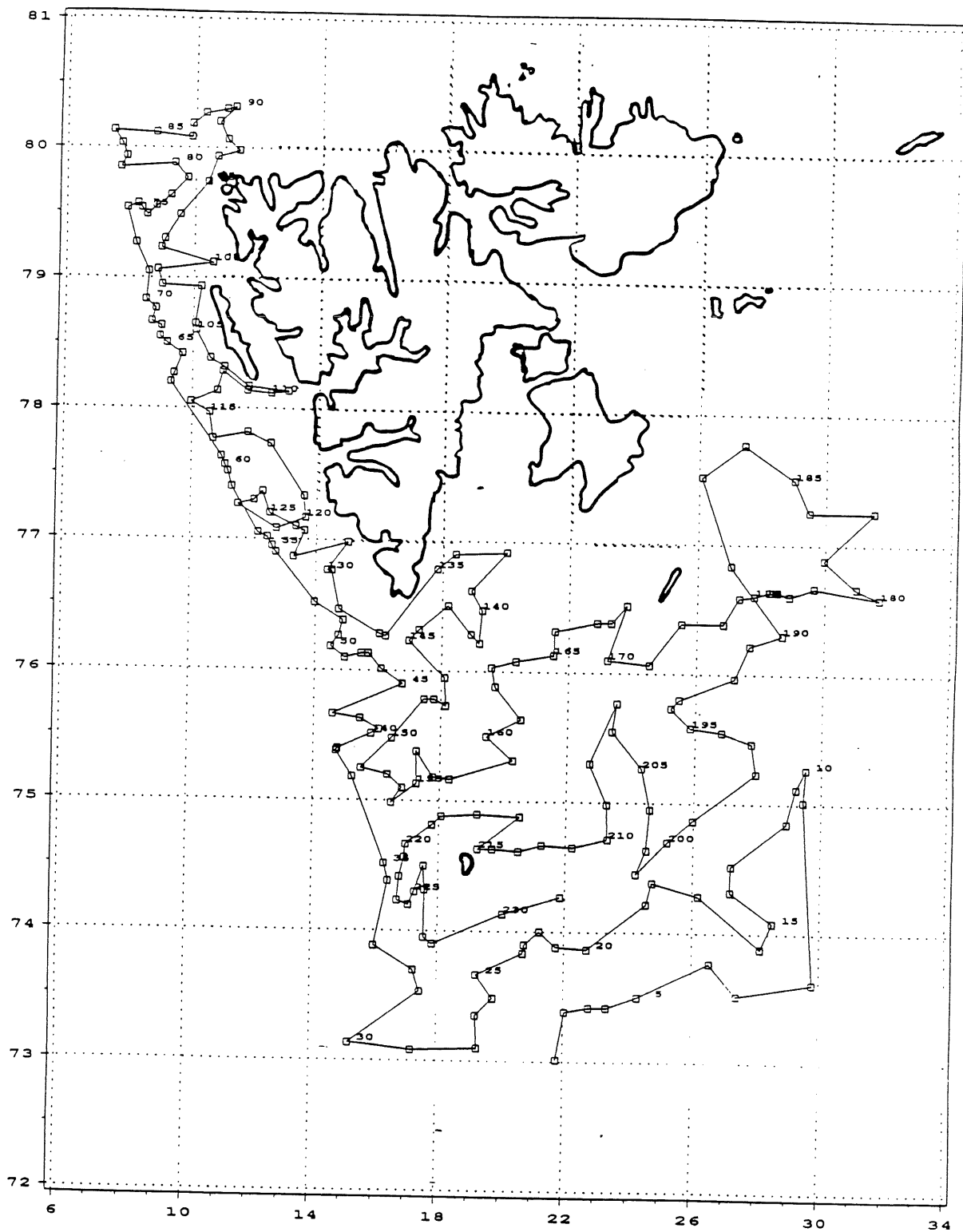


Figure 4. Trawlstations and course tracks for Norwegian survey in the Svalbard area with M/Tr "Anny Kræmer", August - September 1991.

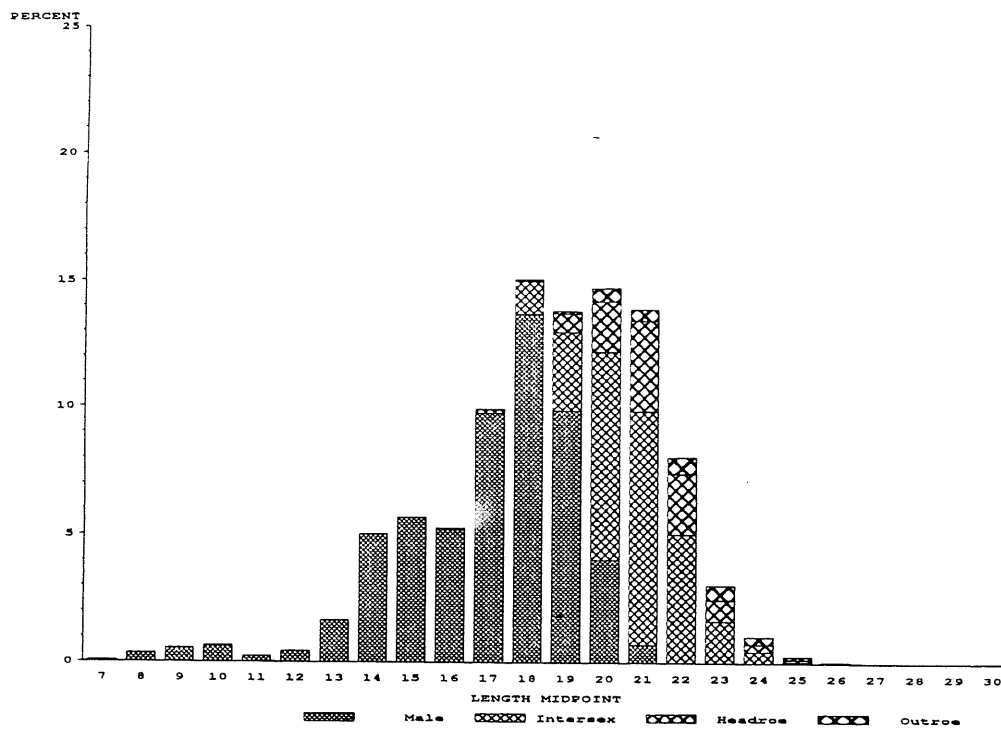


Figure 5a. Length distribution of shrimp from area A, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

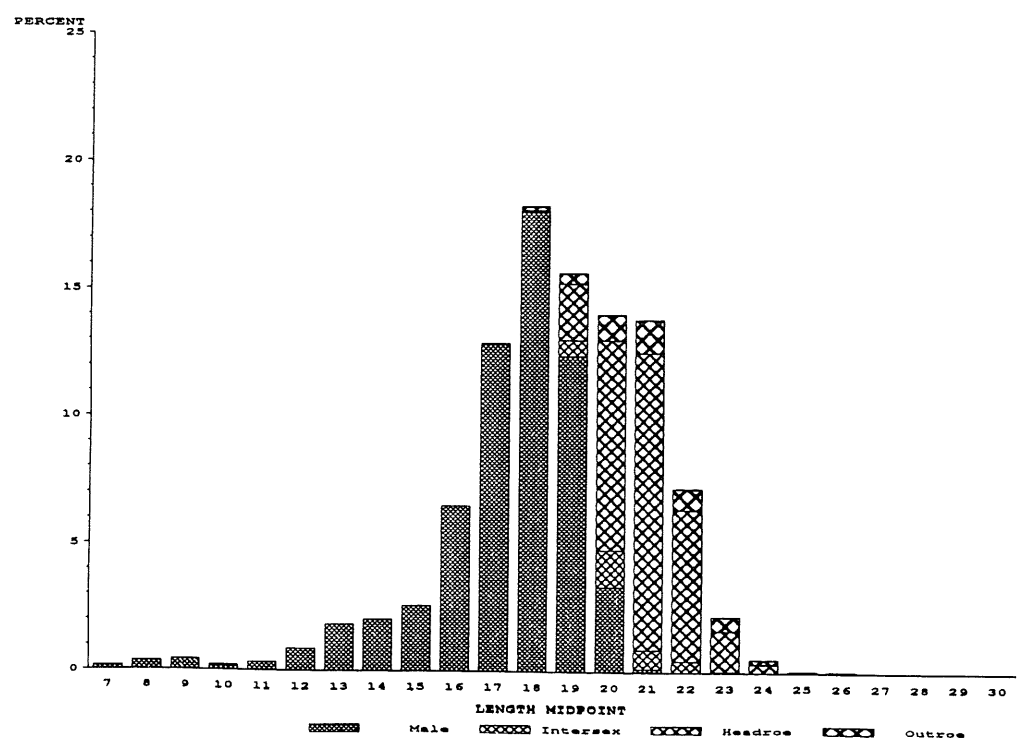


Figure 5b. Length distribution of shrimp from area B, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

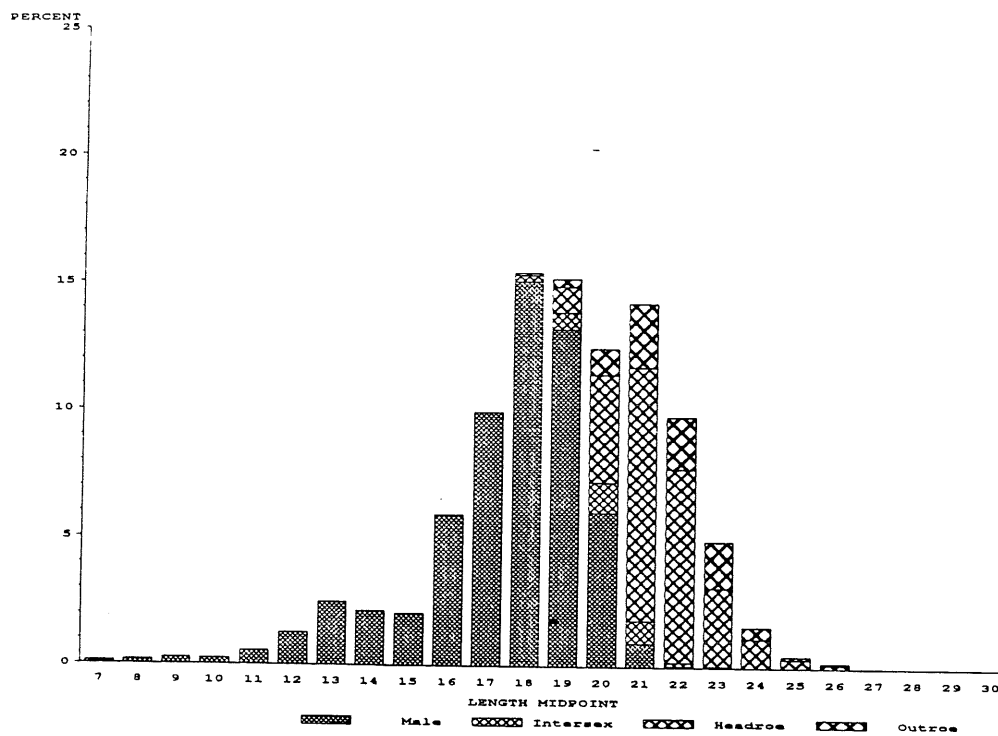


Figure 5c. Length distribution of shrimp from area C, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

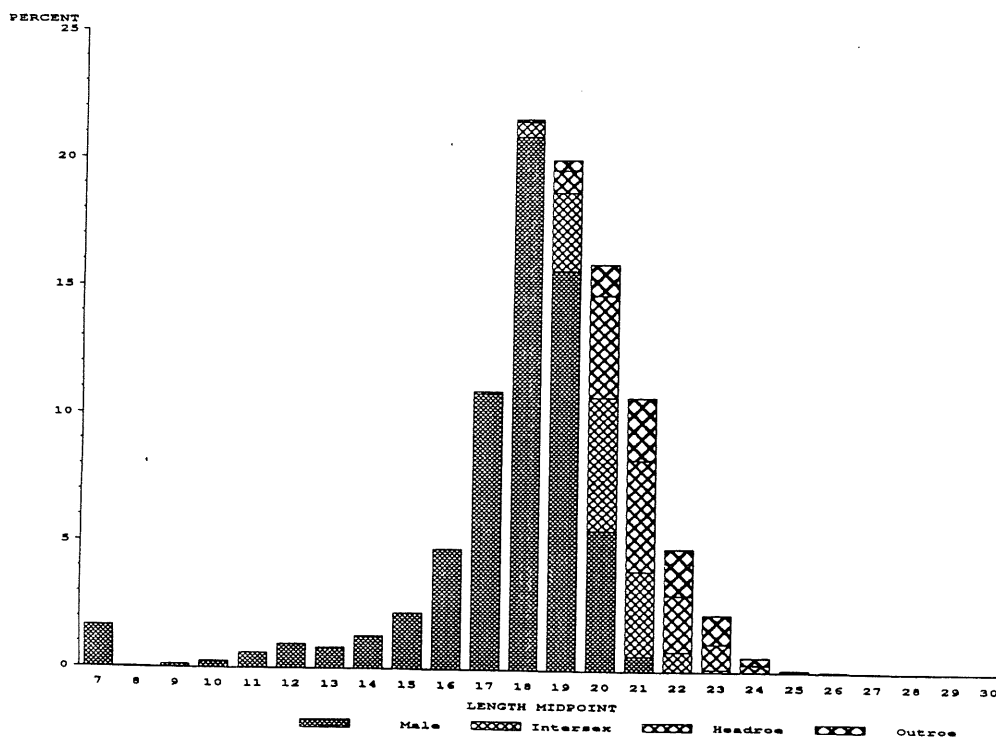


Figure 5d. Length distribution of shrimp from area D, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

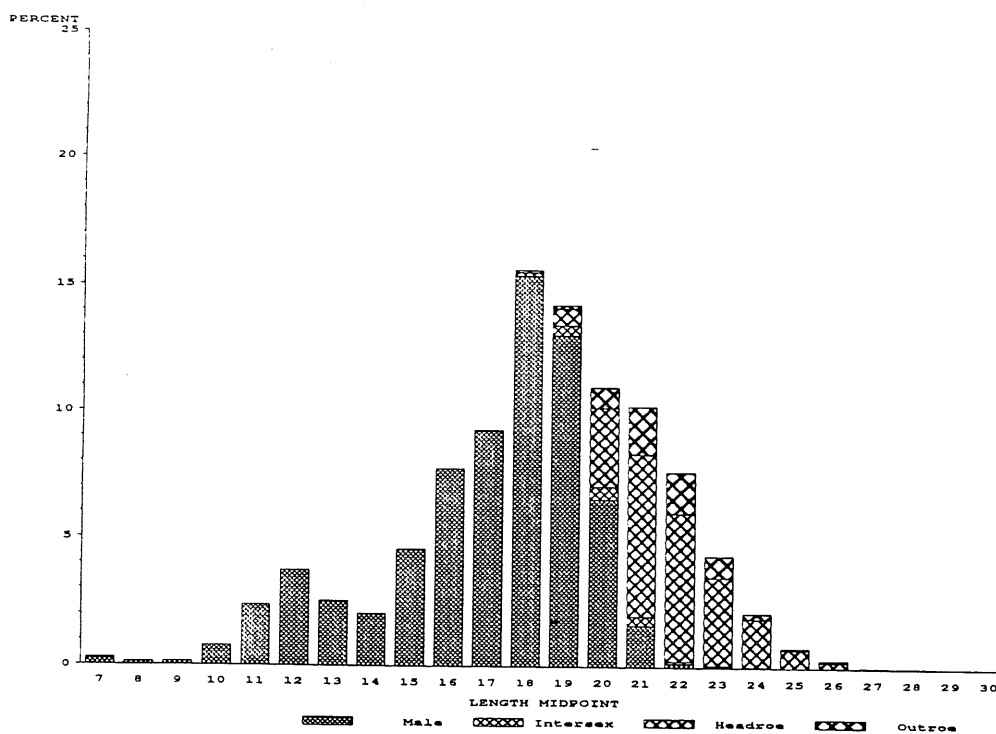


Figure 5e. Length distribution of shrimp from area E, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

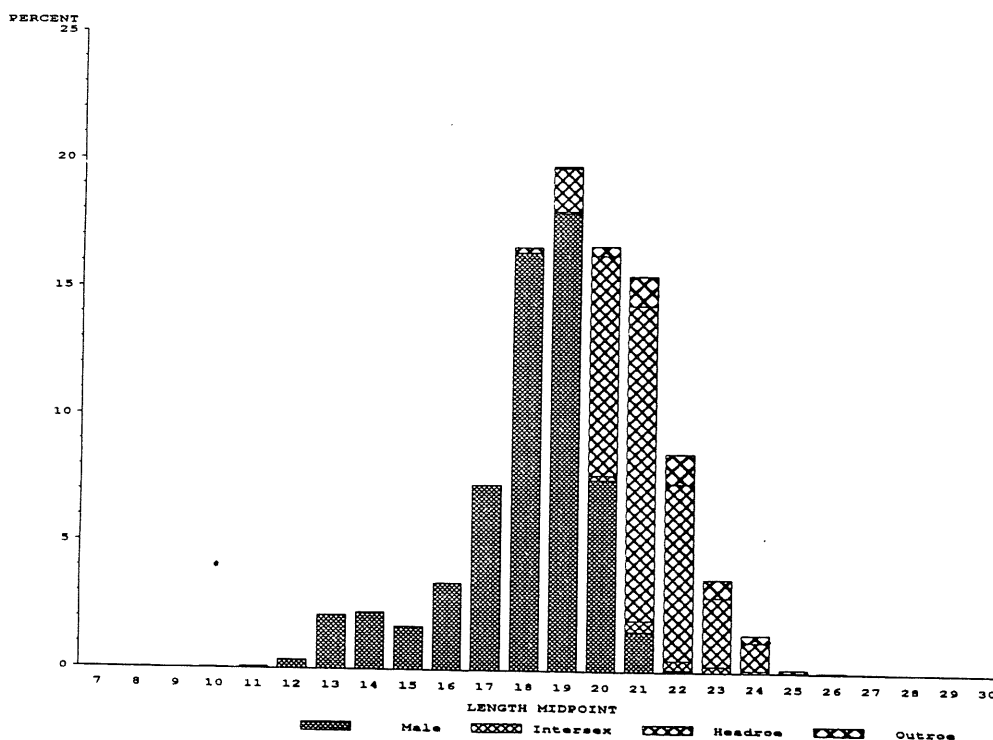


Figure 5f. Length distribution of shrimp from area F, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

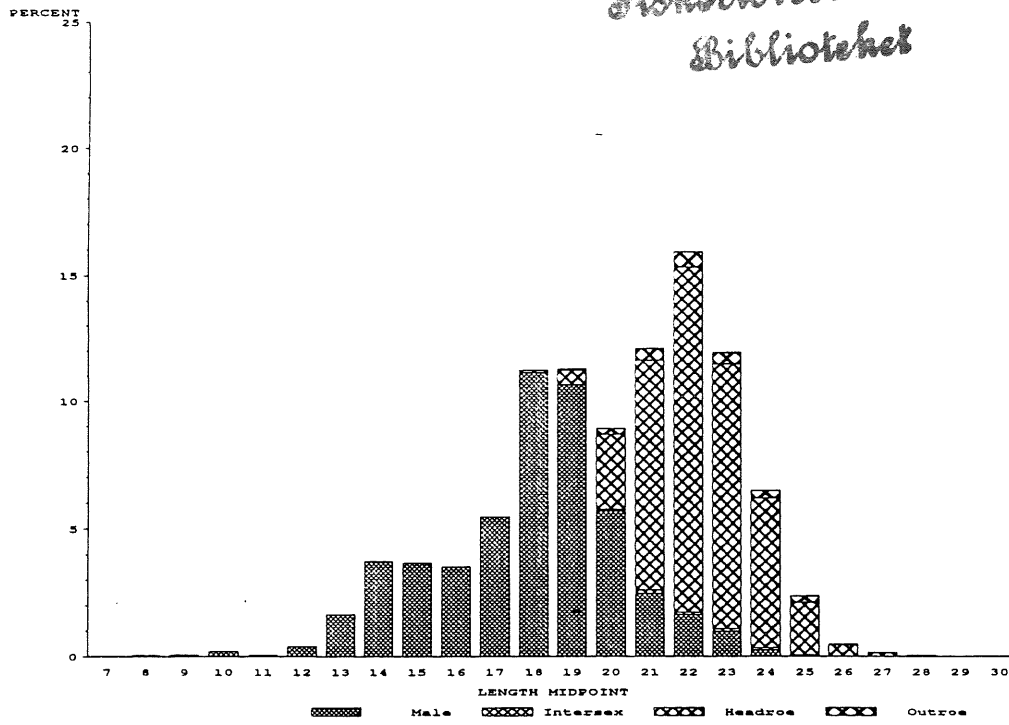


Figure 5g. Length distribution of shrimp from area G, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.

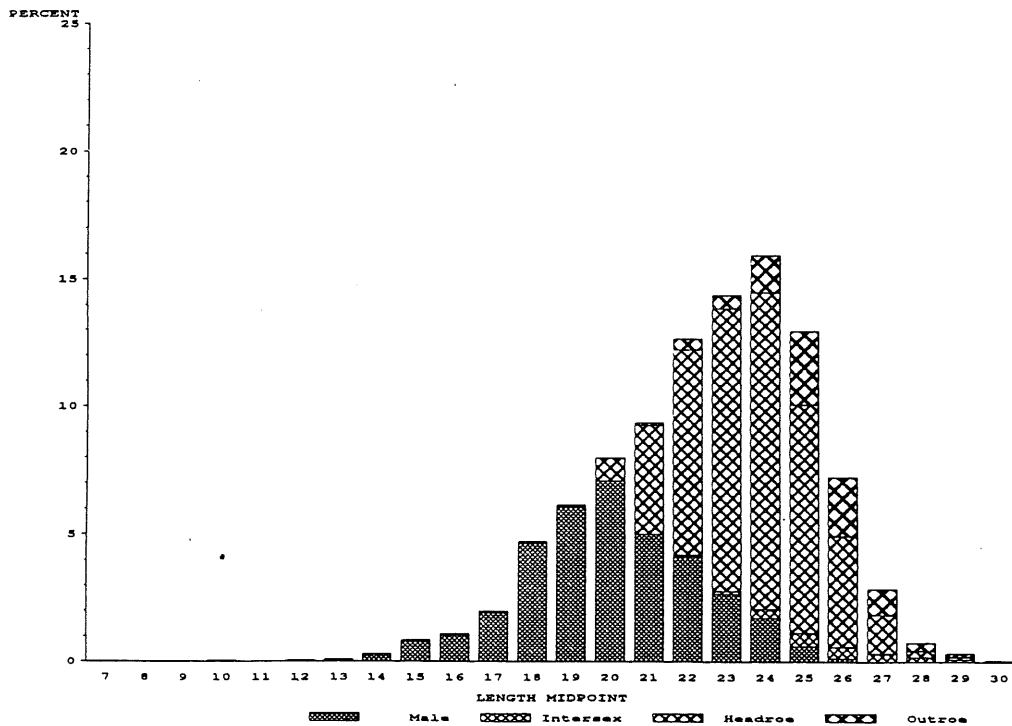


Figure 5h. Length distribution of shrimp from area H, Norwegian survey in 1991. Columns are divided into sexual stages as given in the legend.