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Offshore Trawl Survey for Shrimp (*Pandalus borealis*) in NAFO Subareas 0 and 1, in 1996

by

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Introduction

Since 1988, Greenland Institute of Naturale Resources has conducted an annual stratified-random trawl survey in the offshore areas of the Davis Strait. The main purpurse of this survey is to estimate the trawlable biomass of the West Greenland shrimp stock (*Pandalus borealis*) and to collect information on the size and sex composition of of the stock and to compare the results with previous years surveys (Carlsson and Kanneworff 1989, 1990, 1991, 1992, 1993, Andersen *et al.* 1993, 1994, Carlssons *et al.* 1995a).

The survey covers NAFO Subarea 1 and a small part of eastern Div. 0A in the depth interval 150-600m and is assumed to cover most of the offshore distributional area. In 1991 the survey was expanded to also include the most important inshore distributional area around the Disko Island. This part of the survey is reported in an other series of papers (Carlssons *et al.* 1995b). Together the inshore and offshore survey are belived to cower the total distribution area of the stock.

Materials and methods

The survey was performed with a 722 GRT trawler, " Paamiut" using 3000/20 meshes SKJERVØY bottom trawl with a cod-end was 20 mm (stretched mesh) twin cod-end. Until 1993 44 mm mesh was udes in the cod-end.

Trawl doors used were GREENLAND PERFECT, measuring 370*250 cm and weighing 2420 kg. Trawl geometry was measured every 10 min. with SCANMAR acoustic sensors, mounted on the trawl doors. Trawl performance was observed with a FURUNO trawleye mounted on the headrope.

In order to minimize the influence of vertical migrations of shrimp, the trawl operations are carried out only in the day-time (0900-1900 UTC).Standard towing time was 60 minutes and towing speed is kept around 2.5 knots. The towing time was counted from the moment the pressure on the winches increased after shooting the gear. The termination of the tow was

defined as the moment the winches began to haul. The length of the track is taken as the position (GPS) of the vessel at the beginning and end of each tow.

The mean wingspread is calculated for each haul, based on the measured distance between doors. Swept area is calculated as the distance between starting and ending position, multiplied by the mean wingspread.

Stratification of the survey area is based primarily on information on bottom topography and on the distribution of the commercial fishery. In areas with reliable depth information four depth zones are applied: 150-200m, 200-300 m, 300-400 m, and 400-600 m. Four main regions are established (Fig. 1):

N: The region extends from 69°30'N to 72°'30N, and from an approximated three mile limit from land or from the shallow continental shelf (wherever depth information is available) towards west to 59°W, except from a small area south of 70°N where it extends a few miles further to the west. In this region bottom topography is not known well enough to apply a depth stratification. The region is divided into nine strata, based on the distribution of the commercial fishery.

W: This region includes the offshore West Greenland area south of 69°30'N, west of 48°15'W. The region is divided into seven areas, based on distribution of commercial catches and bottom topography. Each area is further divided into depth strata: 150-200 meters, 200-300 meters, 300-400 meters, and 400-600 meters.

C: The stock area in Canadian territorial waters. The region is divided into two areas with similar depth stratification as in region W.

S: The region includes part of NAFO Div. 1F east of 48°15'W with depths between 150 and 600 meters. As in region N depth stratification is not possible. Based on the distribution of the commercial fishery the region is divided into two strata.

All shrimp in the survey area are believed to belong to the same stock (NAFO, 1994), and the separation of regions merely reflects different methods of stratification and national territories.

The survey was performed as a two-phase stratified-random survey as described in Carlsson *et al.* (1995) using the theoretical approach described by Francis (1984). Stations in phas two were distributed randomly.

Recalculation of biomass estimates for 1988 - 1995 is done in 1996, taking into account minor changes in strata areas over the years and subtracting small quantities of *Pandalus montagui* included in the previous years biomass estimate.

From each haul a sample of approx. 5 kg of shrimp was taken from the codend of the trawl. The shrimp were sorted by sex and the oblique carapax length was measured by slide calliper to the nearest 0.1 mm. The catch was sorted by species and weighed.

The overall length distribution of shrimp in 1996 was separated in age groups by modal analysis (Macdonald and Pitcher, 1979), and compared to the results from modal analysis of overall distribution from ealier years (D. G. Parsons, pers. comm. and NAFO, 1995).

Results and discussion

132 successfull hauls were taken in the offshore survey area in the period between July 5. and August 28 (Fig. 2). Table 1a-1d lists informations on individual stations. The number of hauls and estimated biomass of *P. borealis* per stratum are shown in Table 2a-2d.

Biomass estimate in tons in each of the four regions is shown in the following text table.

Region	Biomass estimate	No. of Hauls	2* Standard deviation
North	9108	22	10325
Canadian	1740	9	3157
West	175651	96	59034
South	3805	5	7281

In Table 3 the biomass is shown by region for each year since 1988. Figure 3 shows the time series of total offshore biomass estmate1988-1996.

The total biomass estimate from the 1996 survey is higher than in 1995, but lower than in 1988 - 1990 and in 1993. In region N there is no overall change from 1995 to 1996. Figure 3 shows that most of the biomass is found in the northern part i.e. north of 71°N (N1-N4), in a pattern similar to the years 1988 to 1993. In 1994 and 1995 relative more of the biomass was found south of 71°N. Most of the biomass in region N is found in the presumed low density areas N2 and N5, while the other strata had a much lower biomass.The area from 69°30'N to 71°N was not covered as well in this survey as in previous years due to ice.

In region C the estimated biomass has fluctuated between 3,000 and 17,000 tons over the previous years of surveys. The estimate from 1996 at 1,740 tons is the lowest in the timeserie.

In region W the decrease seen from 1993 to 1995 has stopped. The increase from 1995 to 1996 is mainly due to an increase in the biomasse in the southermost strata (W6 - W7). In the former important areas W1 and W2 the biomass estimates are low as in 1995.

Biomass estimate for region S has flucturated since this area was incluted in 1992. The flucturations seems to big to reflect real changes in the population.

Table 4 shows the relative distribution of estimated biomass in relation to depth. In 1996, a biomass larger than normal was observed in shallow water (150-200 m). As it is generally believed that shrimp migrate towards north and to greater depth as they grow (Carlsson et al. 1993), the results indicate a possible recruitment of small shrimp to the southernmost area.

To visualise the survey results, shrimp distribution was calculated with the spline method (Stolyarenko, 1987) and plotted on maps. Figure 4 a-c show contour maps of the shrimp distribution in 1996 and show the same trends as described above.

Length frequencies from individual hauls were weighted by catch and swept area and combined to mean abundance by length per stratum. Overall abundance by length was calculated by adding mean abundances by length from all strata.

The overall length distribution of shrimp in 1996 was separated in age groups by modal analysis (Macdonald and Pitcher, 1979), and compared to results from modal analysis of overall distributions from earlier years.

Stock composition.

Number of shrimp in overall length distributions for the survey area from 1991 to 1996 were:

No. of Shrimp (billions)	1991	1992	1993	1994	1995	1996
males	12.2	20.9	31.8	25.0	18.0	32.9
females	4.4	5.5	7.9	6.4	5.1	5.6
Total	16.6	26.5	39.7	31.4	23.1	38.5

From 1993 to 1996 the total number of shrimp may be biased upwards when compared to earlier years due to the introduction in 1993 of a 20 mm mesh size in the cod-end of the survey gear (compared to 44 mm used before) and hence a better representation of younger male groups.

Total number of shrimp increased from 1995 to 1996 (about 67%), in accordance with the increase in biomass estimate. The increase is based on a significant increase in number of males (about 83%) and a minor increase in females (about 10%). In 1996 number of males is at level with the numbers in years of highest male abundance, namely 1989 and 1993.

Overall length distributions for the total survey area in 1991-96 are shown in Fig. 5, and abundance at length in 1996 in Table 5. In 1996 three modes of males dominate at 14, 18, and 21 mm carapace length (CL). The mode at 21 mm CL is probably representing the 1990 year class, which dominated the male distribution in 1995 at 20 mm CL. The mode at 18 mm CL may be interpreted as a merging of the modes of the 1992 and 1991 year class. The significant mode at 14 mm CL is probably representing the 1993 year class (age 3).

When the very large 1985 year class first showed up in survey results in 1989, it was four years old and totally dominated the length frequency at 17.5 mm CL (ref.). If a smaller mesh size had been used in the cod-end of the survey gear in 1988, the 1985 year class might have been found this year around 14 mm CL, but it is not known how well it would have been recruited to the survey area and to the gear. The 1985 year class (or at least a considerable amount of it) changed sex and took part in the spawning for the first time at age 7 in 1992. The 1993 year class should thus mainly be offspring of the 1985 year class. As such a large peak at 14 mm CL has never been seen before in survey results, it may promise a very good recruitment to the fishery in a few years, although it is not possible at present to judge actual size of the year class or to compare it to the strength of the 1985 year class.

As in earlier years female modes are found at 25 mm (primiparous) and 26 mm CL (multiparous). The primiparous distribution is assumed to consist primarily of transitioned shrimp from the 1989 year class, which occurred in the male distribution at 22 mm CL in 1995 as a year class of mean strength.

Figures 6a and 6b show total length frequencies by stratum in 1996. Strata north of 69°30'N are combined into two strata NW (includes N1-N4) and NS (includes N5-N9), while strata on the Canadian side of the midline are combined into stratum C (includes C1 and C3).

The male group around 21 mm CL (assumed to be the 1990 year class) is present in all strata. This year class is equally distributed in strata W1-W3 and W5-W6 and dominates in the northern part of the main survey area (strata W1-W3) as it did in 1995 (ar 20 mm CL). The 1991 year class with a mode around 19-19.5 mm CL appears to be small compared to the 1990 year class - it is probably most numerous in strata W1-W3. The 1992 year class with a mode around 17-18 mm CL is present in significant amounts in strata W1-W3 and W5-W6, and is most numerous in W5, where it is the most dominating year class. The 1993 year class is present in all strata, but most numerous in the southermost strata W5 and W6, where also the 1985 year class showed up in considerable amounts in 1989.

Females are most abundant in stratum W2 and W5. In most strata female modes are found at 25 mm (primiparous) and 26 mm CL (multiparous), but different from earlier years very few females were observed in stratum C, probably caused by the bad coverage of this area in 1996.

Results of modal analysis of the overall length frequency distributions are shown in Table 6. Results from 1988-1994 were taken from Don Parsons (pers. comm.) and NAFO (1995). Analysis of the 1996 distribution was troublesome due to extensive overlap of age 4, 5, and 6, but based on visual inspection of length frequencies by stratum (Fig. 6a and 6b) a run with constrained proportions of age 5 and age 6 and with a fixed C.V. of 0.06 was judged to yield the best description of the overall length distribution.

Abundance at age indicates a relatively strong 1990 year class in 1996 (as in 1995), which should recruit to the female stock in 1997. The 1991 year class seems of less importance, while the 1992 year class is promising in terms of stable recruitment. The present abundance of 3 years old shrimp (the 1993 year class) may indicate that a new dominating year class like that of 1985 will recruit to the fishery in three years.

Conclusions

The total biomass estimates from the surveys in the period 1988-96 indicate a generally stable situation apart from a low level in 1991. The decline seen from 1993 to 1995 has stopped in 1996 and the increase in biomass estimate is found in the southern part of the area.

Overall length distribution and results from modal analysis indicate a relative strong 1990 year class and recruitment of several year classes of smaller shrimp. Females and larger older males were most abundant in the northern strata in the main area, with smaller males dominated in the southern strata W5 and W6.

As in 1995 overall length distributions and results from modal analysis indicate a relatively strong 1990 year class and recruitment of several year classes of smaller shrimp, of which the 1993 year class is more abundant than observed before for three years old males. This year class is supposed mainly to be offspring of the very abundant 1985 year class, and its abundance in 1996 may indicate that a new very strong year class will recruit to the fishery in a few years. Females and larger older males were most abundant in the northern strata in the main area, while smaller males dominated in the southern strata W5 and W6. Abundance of shrimp was low on the Canadian side of the midline, but this might be the result of ice hindering the access to areas of higher shrimp abundance.

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Tabel 1a. List of trawl stations in strata west of the midline (C), and north of 69°30'N (N) in Davis Strait.

Stratum	Position (lat)	Position (long)	Depth (m)	Trawltime (min)	Catch (kg)
C1-3	68°16.71N	59°15.86W	345	60	2,29
	68°22.06N	59°03.91W	325	60	1,93
	68°30.36N	59°00.91W	317	60	0,23
C3-2	67°43.41N	58°17.66W	284	60	12,4
	68°06.46N	58°38.51W	273	60	0,17
C3-3	67°35.36N	58°25.16W	324	60	5,48
	67°52.01N	58°42.56W	371	60	281,5
C3-4	67°38.16N	58°42.66W	520	60	0,83
	67°47.71N	59°00.01W	461	60	11,1
N1	72°16.51N	57°24.76W	361	60	36,8
	72°14.06N	57°49.91W	364	60	9,3
	72°17.41N	58°33.06W	295	60	0
	71°58.26N	56°22.71W	227	60	0,02
N2	71°01.36N	58°32.96W	397	60	169,28
	71°05.66N	58°28.31W	373	60	34,7
	71°04.46N	57°52.21W	313	60	0
	72°11.36N	56°37.41W	191	55	0
	71°44.96N	56°27.66W	187	60	0
N3	71°30.56N	56°19.86W	285	60	24,3
	71°25.16N	56°19.56W	278	60	30,7
N4	71°05.11N	57°32.56W	323	60	0
	71°09.11N	56°00.26W	310	60	20,05
	71°02.86N	56°19.81W	384	60	72,4
N5	70°35.46N	57°36.46W	475	60	0,04
	70°49.31N	58°24.46W	458	60	1,98
	70°54.01N	56°20.16W	543	60	29,9
	70°50.81N	56°42.31W	565	60	57,5
N6	70°34.81N	56°31.91W	426	35	0,64
N7	70°36.31N	55°51.46W	319	60	8,93
	70°41.16N	55°42.86W	462	60	2,76
N8	70°28.51N	56°09.96W	185	40	0

Table 1b. List of trawl stations in strata between 67°00'N and 69°30'N, east of the midline in Davis Strait.

Stratum	Position (lat)	Position (long)	Depth (m)	Trawltime (min)	Catch (kg)
W1-1	69°22.26N	56°24.31W	162	60	0,01
	69°17.61N	54°42.11W	165	60	0
	68°51.11N	56°10.81W	169	60	0
W1-2	69°09.51N	57°40.81W	265	60	0
	69°23.71N	57°18.66W	220	60	0
	69°21.86N	56°56.51W	205	60	0
	69°27.06N	55°06.86W	254	60	0,73
	69°22.21N	57°56.01W	290	37	0
	69°11.66N	58°11.76W	280	60	0,03
	68°58.76N	57°09.11W	251	60	0,14
W1-3	68°40.76N	56°27.66W	340	60	167,2
	68°41.71N	56°43.56W	325	60	90,5
	68°42.36N	57°01.96W	316	60	84,4
	68°44.76N	57°34.31W	309	60	4,77
	68°31.11N	57°40.71W	355	60	577,3
	68°25.56N	57°11.06W	346	60	383,3
W2-1	68°47.66N	54°36.16W	188	60	0
W2-2	68°18.51N	54°36.16W	272	60	0,41
	68°14.31N	54°43.56W	227	60	0,02
	68°02.31N	54°08.41W	260	60	1,15
	69°01.66N	54°54.71W	214	60	0
	68°53.61N	55°14.36W	228	60	0
	68°43.21N	55°20.16W	260	60	0,03
	68°31.36N	54°29.01W	291	60	0,5
W2-3	68°33.11N	55°37.06W	354	60	668,1
	68°30.91N	55°26.41W	373	53	443,5
	68°18.21N	54°14.71W	375	60	347,8
	68°17.01N	54°52.31W	363	60	389,1
W2-4	68°20.11N	54°08.41W	454	60	157,42
	68°22.96N	54°14.21W	476	60	1842,6
	68°42.96N	54°05.16W	522	60	538,5
	68°20.11N	54°08.36W	458	60	320,7
	68°20.51N	54°50.01W	418	60	1381,1
	68°23.96N	54°59.81W	458	60	314,8
W3-1	67°13.91N	56°28.96W	174	60	0
	67°34.01N	56°37.21W	184	60	0
	67°57.31N	56°32.66W	159	60	0
W3-2	67°02.11N	56°26.61W	214	60	0
	67°16.26N	57°06.56W	272	60	2,93
	67°22.31N	57°08.96W	218	60	0,01
	67°27.41N	57°35.36W	239	60	0,2
	67°47.41N	56°57.21W	233	44	0
	68°14.46N	56°13.96W	269	60	1,01
W3-3	67°12.06N	57°00.51W	366	60	627,8
	67°58.76N	57°38.06W	343	60	270,4
	67°59.46N	58°06.76W	376	60	932,2
	68°17.06N	56°21.01W	368	60	353,7
	68°02.86N	57°59.16W	377	60	721
	67°55.66N	58°03.11W	337	60	177,1
	67°52.31N	57°41.21W	301	60	13,9
W3-4	67°06.31N	56°56.71W	492	60	78,5
	68°22.66N	55°52.31W	516	60	246,7
	68°18.56N	56°52.11W	443	60	572,5
	68°14.81N	57°19.61W	409	60	741,1

Table 1c. List of trawl stations in strata between 59°30'N and 67°00'N in the Davis Strait survey.

Stratum	Position (lat)	Position (long)	Depth (m)	Trawltime (min)	Catch (kg)
W4-1	66°17.76N	56°03.11W	159	60	0,09
	66°25.36N	56°01.31W	178	60	0
	66°16.76N	55°18.96W	199	60	0,02
	66°29.61N	55°24.46W	192	60	0
	66°36.16N	55°44.76W	157	60	0
W4-2	66°21.11N	55°06.01W	233	60	0,06
	66°57.71N	56°26.61W	275	60	0
W4-3	66°40.61N	54°09.41W	360	60	223,2
	66°29.76N	54°36.76W	345	60	506,1
W4-4	66°00.81N	56°18.86W	499	35	1,6
	66°09.91N	56°36.36W	578	60	1,76
	66°50.46N	56°31.41W	466	60	4,42
W5-1	64°22.66N	54°02.06W	165	60	0
	64°58.91N	54°33.66W	179	60	0,01
	64°29.06N	53°27.91W	174	60	0
W5-2	64°00.71N	53°11.86W	238	60	384,2
	64°19.61N	54°14.81W	233	31	0,3
	65°11.91N	53°13.66W	226	29	7
	65°01.26N	53°09.66W	241	60	2507,8
	64°59.81N	53°05.91W	290	60	905,3
	64°39.21N	54°31.46W	266	60	4,95
	64°36.61N	54°30.66W	272	60	5,4
	64°31.81N	54°35.91W	275	60	39,5
W5-3	64°12.61N	53°16.91W	345	60	641,2
	64°34.81N	53°03.31W	357	60	644,6
	64°55.16N	53°02.91W	372	60	1700,4
W5-4	64°19.96N	53°01.51W	485	60	315,9
	64°23.36N	52°52.06W	525	60	184,8
	64°52.91N	55°01.96W	541	60	0
	65°51.21N	55°59.71W	518	60	40,6
W6-1	62°14.81N	50°35.11W	151	60	0
	63°00.36N	51°47.66W	183	60	2250,7
W6-2	62°28.91N	51°01.11W	252	60	136,61
	62°55.91N	51°53.86W	265	60	650,5
W6-3	63°01.96N	51°35.56W	347	60	253,6
	63°30.71N	52°40.01W	341	60	415,6
W6-4	63°36.16N	52°12.51W	480	60	156,8
W7-1	61°01.26N	49°19.01W	150	36	0
	60°47.31N	49°12.86W	195	51	0,13
W7-2	61°29.56N	50°25.21W	237	60	0,16
	60°50.36N	49°15.61W	219	27	2,44
W7-3	61°05.41N	49°35.86W	319	35	1752

Table 1d. List of trawl stations in south Greenland (Julianehaab Bay).

Stratum	Position (lat)	Position (long)	Depth (m)	Trawltime (min)	Catch (kg)
S1	60°12.01N	47°07.16W	320	60	3,95
	60°22.61N	46°15.21W	412	45	204,9
S2	60°18.96N	48°01.86W	180	60	0,37
	59°33.31N	45°29.86W	212	27	0,01
	59°30.26N	44°53.26W	223	46	3,23

Table 2a. Estimated trawlable biomasse in Canadian strata west of the midline.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
C1-3	655	10.6	3	7.9	4.5	2	15
C3-2	660	45.0	2	62.1	43.9	1	89
C3-3	1192	1639.3	2	2230.6	1577.3	62	3217
C3-4	623	45.3	2	55.9	39.6	6	85

Table 2b. Estimated trawlable biomass in strata north of 69°30'N.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA N1	3664	496.8	4	777.8	388.9	0	1637
AREA N2	11740	5930.1	5	11228.5	5021.5	0	25793
AREA N3	368	120.4	2	20.4	14.4	106	135
AREA N4	2257	946.4	3	1095.1	632.3	0	2146
AREA N5	5766	1471.6	4	1878.1	939.0	4	4073
AREA N6	3237	45.2	1	.	.	45	45
AREA N7	1029	97.1	2	76.2	53.9	43	151
AREA N8	8063	0.0	1	.	.	0	0

Table 2c. Estimated trawlable biomass in strata south of 69°30'N east of the midline (area W1-W7).

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
W1-1	2416	0.1	3	0.2	0.1	0	0
W1-2	5295	10.1	7	20.3	7.7	0	55
W1-3	9239	25702.3	6	26112.1	10660.2	582	68662
W2-1	1857	0.0	1	.	.	0	0
W2-2	3026	11.6	7	17.8	6.7	0	48
W2-3	2158	13161.7	4	4373.1	2186.5	9706	19312
W2-4	1723	15644.7	6	14912.2	6087.9	3519	41701
W3-1	2215	0.0	3	0.0	0.0	0	0
W3-2	4810	38.9	6	63.6	26.0	0	161
W3-3	2714	14034.9	7	9954.1	3762.3	477	25871
W3-4	3361	12500.5	4	8451.2	4225.6	3239	21330
W4-1	4252	1.3	5	2.3	1.0	0	5
W4-2	1791	0.8	2	1.1	0.8	0	2
W4-3	812	3608.6	2	1771.5	1252.7	2356	4861
W4-4	1967	78.6	3	46.6	26.9	41	131
W5-1	1995	0.1	3	0.1	0.1	0	0
W5-2	3454	22788.1	8	40491.6	14316.0	37	114835
W5-3	1797	20832.6	3	11979.6	6916.5	13206	34640
W5-4	2806	4232.3	4	4514.1	2257.0	0	9985
W6-1	1095	17988.9	2	25440.1	17988.9	0	35978
W6-2	1491	7393.4	2	5988.1	4234.2	3159	11628
W6-3	1300	5550.3	2	1458.5	1031.3	4519	6582
W6-4	884	1472.4	1	.	.	1472	1472
W7-1	2419	2.3	2	3.3	2.3	0	5
W7-2	985	29.0	2	38.7	27.4	2	56
W7-3	239	10567.9	1	.	.	10568	10568

Table 2d. Estimated trawlable biomass in strata in South Greenland (Julianehaab Bay).

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
S1	1993	3742.8	2	5147.7	3639.9	103	7383
S2	3198	62.7	3	96.2	55.5	1	173

Table 3. Sums of estimated biomass in the main regions 1988-1996 (region 'South' excluded from total).

	Biomass in Year								
Area	1988	1989	1990	1991	1992	1993	1994	1995	1996
West	152928	189729	188323	115214	155980	210463	162213	130169	175651
Canada	9305	3870	11398	4776	16763	3609	7036	5138	1740
North	19613	13269	11955	5324	18826	8480	8473	9788	9108
South	-	-	-	-	483	19872	22053	1783	3805
Total	181846	206868	211676	125314	191569	222552	177722	145095	186499

Table 4. Relative distribution (%) of estimated biomass 1988-1996 in depth strata south of 69° 30'N (region C and W).

	Depth Stratum			
Year	150-200	200-300	300-400	400-600
1988	8,3	27,2	49,9	14,6
1989	4,9	52,4	35,3	7,4
1990	0,1	21,9	55,2	22,8
1991	0,2	11,8	62,2	25,8
1992	2,2	20,5	60,9	16,5
1993	0,0	23,3	58,8	18,1
1994	0,2	18,2	68,1	13,5
1995	4,1	14,0	58,9	23,1
1996	10,1	17,1	53,6	19,2

CL	Males	Prim.fem.	Mul.fem.	Total
5.0	0.0	0.0	0.0	0.0
5.5	0.0	0.0	0.0	0.0
6.0	0.6	0.0	0.0	0.6
6.5	3.0	0.0	0.0	3.0
7.0	19.6	0.0	0.0	19.6
7.5	58.7	0.0	0.0	58.7
8.0	121.1	0.0	0.0	121.1
8.5	151.7	0.0	0.0	151.7
9.0	187.4	0.0	0.0	187.4
9.5	133.0	0.0	0.0	133.0
10.0	113.0	0.0	0.0	113.0
10.5	137.3	0.0	0.0	137.3
11.0	225.1	0.0	0.0	225.1
11.5	387.3	0.0	0.0	387.3
12.0	534.6	0.0	0.0	534.6
12.5	847.4	0.0	0.0	847.4
13.0	1183.4	0.0	0.0	1183.4
13.5	1520.4	0.0	0.0	1520.4
14.0	1703.0	0.0	0.0	1703.0
14.5	1541.3	0.0	0.0	1541.3
15.0	1306.8	0.0	0.0	1306.8
15.5	1101.9	0.0	0.0	1101.9
16.0	969.4	0.0	0.0	969.4
16.5	1151.5	0.0	0.0	1151.5
17.0	1384.3	0.7	0.0	1385.0
17.5	1481.2	0.3	0.0	1481.5
18.0	1517.6	0.0	2.0	1519.6
18.5	1375.0	0.7	1.0	1376.8
19.0	1289.3	1.1	1.4	1291.8
19.5	1283.6	0.0	1.9	1285.6
20.0	1504.4	5.9	7.6	1518.0
20.5	1700.9	5.1	2.4	1708.5
21.0	1858.3	5.7	5.9	1869.8
21.5	1687.9	11.1	2.4	1701.3
22.0	1447.9	32.1	12.0	1492.0
22.5	1088.0	42.1	27.0	1157.0
23.0	764.6	97.8	58.6	921.0
23.5	489.5	154.3	117.5	761.3
24.0	278.8	268.8	210.2	757.9
24.5	155.7	360.1	312.7	828.5
25.0	57.4	368.2	398.1	823.7
25.5	33.8	326.0	386.4	746.2
26.0	19.7	204.3	438.2	662.2
26.5	9.3	145.7	412.7	567.7
27.0	3.9	80.6	316.2	400.7
27.5	0.3	25.3	262.1	287.8
28.0	2.7	9.6	179.6	191.9
28.5	0.8	6.7	138.3	145.9
29.0	2.5	1.9	82.6	87.0
29.5	1.9	0.2	47.1	49.1
30.0	1.9	0.5	24.4	26.8
30.5	3.6	0.0	7.6	11.2
31.0	1.2	0.0	6.9	8.1
31.5	3.1	0.0	2.6	5.7
32.0	2.5	0.0	0.7	3.2
32.5	0.6	0.0	0.5	1.1
33.0	0.6	0.0	0.3	0.9
33.5	0.0	0.0	1.4	1.4
34.0	0.0	0.0	0.0	0.0
34.5	0.0	0.0	0.0	0.0
35.0	0.0	0.0	0.0	0.0
35.5	0.0	0.0	0.0	0.0
36.0	0.0	0.0	0.0	0.0
36.5	0.0	0.0	0.0	0.0
Total	32850.2	2155.0	3468.4	38473.6

Table 5. Numbers of shrimp (millions) per length group (CL) in total biomass estimate in 1996.

Table 6. Length and percents-at-age of males, and abundance-at-age of all shrimp based on modal analysis of total length frequency distributions from the survey area 1988-1996.

Males, lengths-at-age										
Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	Mean
1						9,3	8,5	8,5	8,5	8,7
2	12,3	12,6	12,0	12,7	13,2	11,9	11,9	10,9	11,6	12,1
3	14,7	15,4	14,0	15,8	15,1	14,1	14,3	13,7	13,8	14,5
4	17,4	17,3	16,8	17,3	17,2	16,9	16,8	17,1	16,8	17,1
5	19,9	19,5	19,2	19,8	19,3	19,3	19,5	19,7	19,2	19,5
6	22,3	22,1	21,2	21,5	22,0	21,8	22,0	22,3	21,4	21,8

Males, percents-at-age										
Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	Mean
1						1,6	1,0	2,9	2,2	1,9
2	2,3	1,4	3,8	1,3	3,4	6,8	5,3	2,7	5,8	3,6
3	4,7	14,5	4,8	5,2	11,8	10,7	9,6	6,3	24,2	10,2
4	19,0	50,1	14,4	14,1	15,1	22,5	26,4	20,0	21,3	22,5
5	39,2	21,9	53,4	18,1	27,1	32,1	27,9	42,1	18,2	31,1
6	34,8	12,1	23,6	61,3	42,7	26,3	29,8	26,0	28,3	31,7
Total	100	100	100	100	100	100	100	100	100	101

Abundance-at-age, all shrimp (billions)										
Age	1988	1989	1990	1991	1992	1993	1994	1995	1996	Mean
1						0,5	0,3	0,5	0,7	0,5
2	0,4	0,4	0,8	0,2	0,7	2,2	1,3	0,5	1,9	0,9
3	0,9	4,6	1,1	0,6	2,5	3,4	2,4	1,1	8,0	2,7
4	3,4	16,0	3,2	1,7	3,2	7,2	6,6	3,6	7,0	5,8
5	7,1	7,0	11,7	2,2	5,7	10,2	7,0	7,6	6,0	7,2
6	6,3	3,9	5,2	7,5	8,9	8,4	7,5	4,7	9,3	6,8
7+	7,7	6,0	8,0	4,4	5,5	7,9	6,4	5,1	5,6	6,3
Total	25,8	37,9	29,9	16,6	26,4	39,7	31,4	23,1	38,5	23,9

Figure 1. Stratification scheme for west Greenland offshore shrimp survey showing stratum labels as used in tekst.

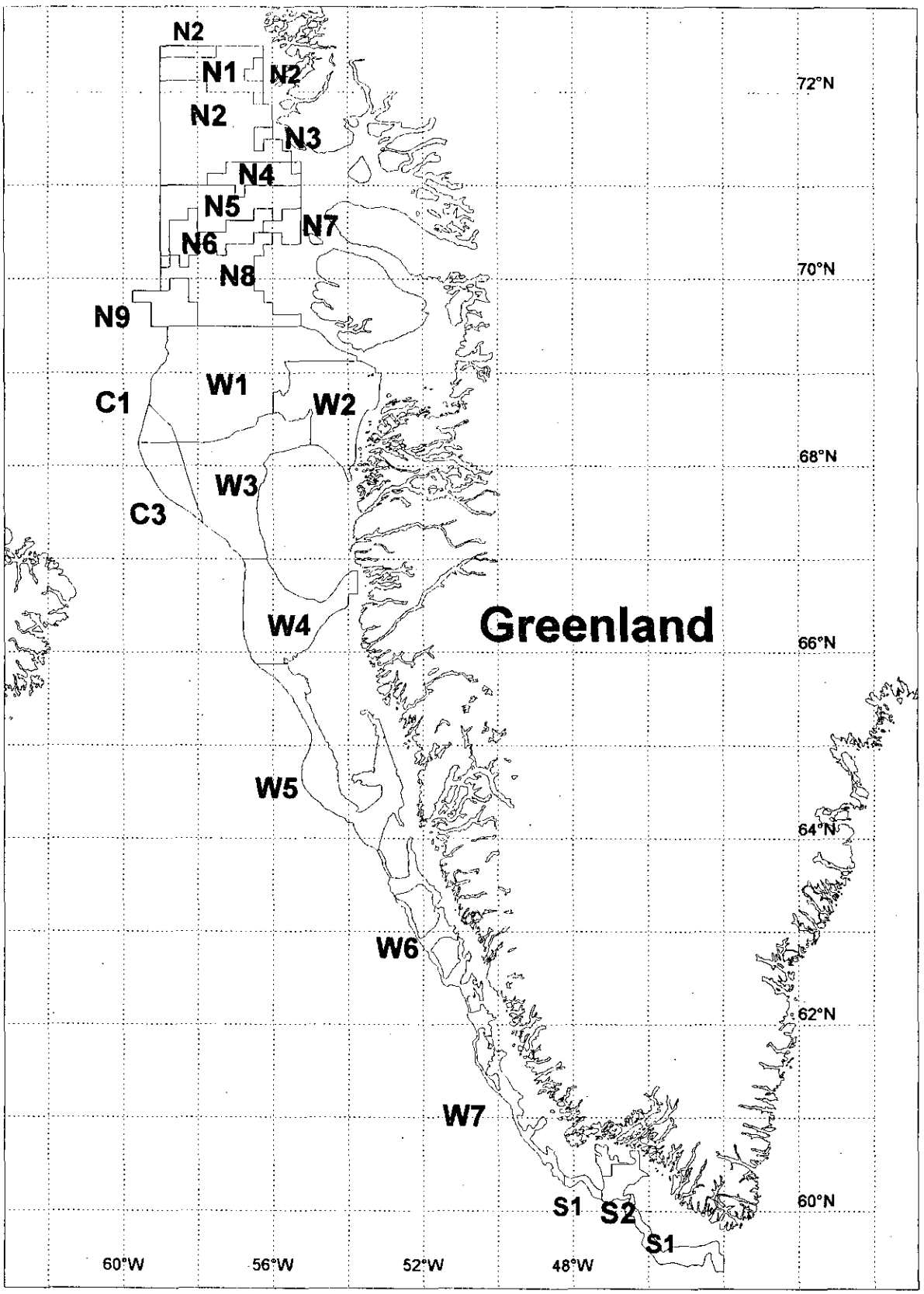
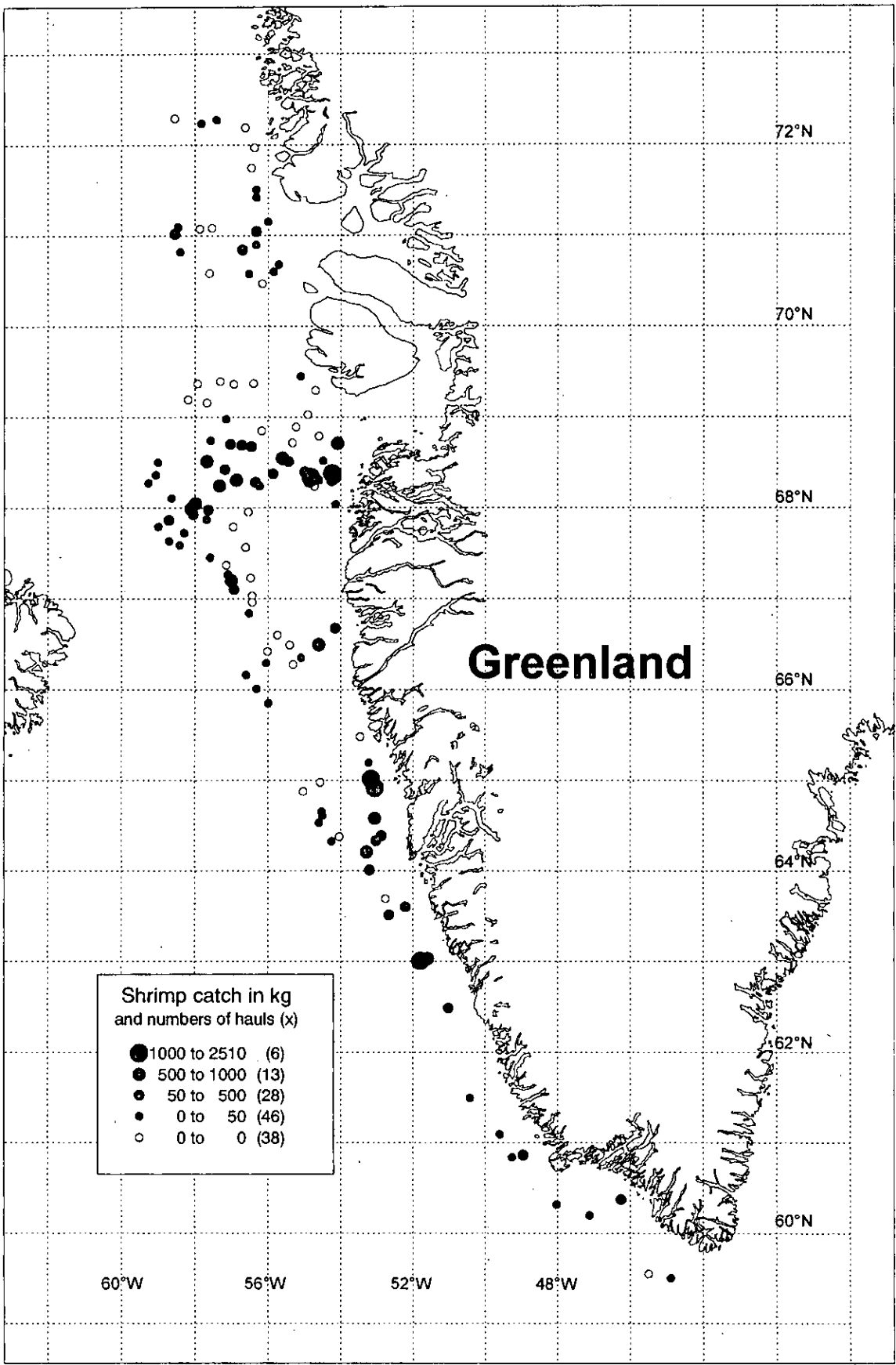


Figure 2. Sampling sites and catch of shrimp in the West Greenland offshore trawl survey.



Figur 3. Estimated total biomass 1988-1996 for groups of strata in the Davis Strait.

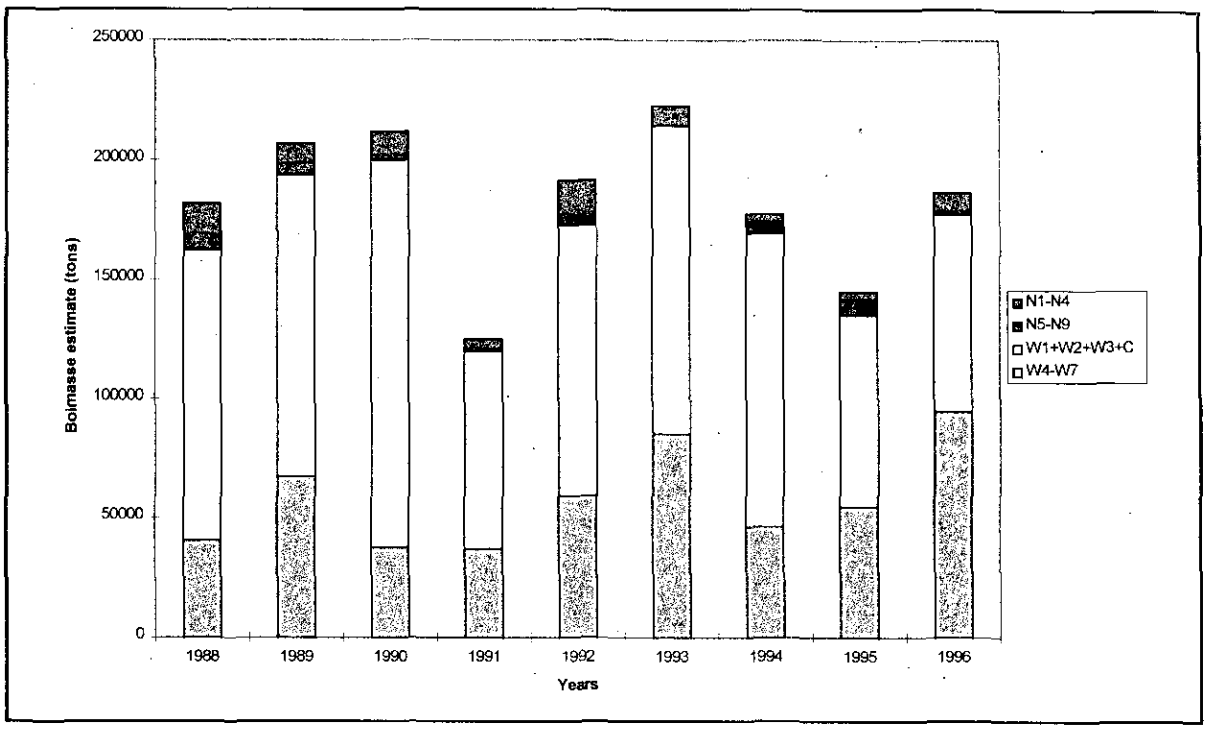


Figure 4a. Conture map with estimated shrimp density for the area 67° N - 69°30' N, calculated with the 'Spline' method. Sampling sites also given.

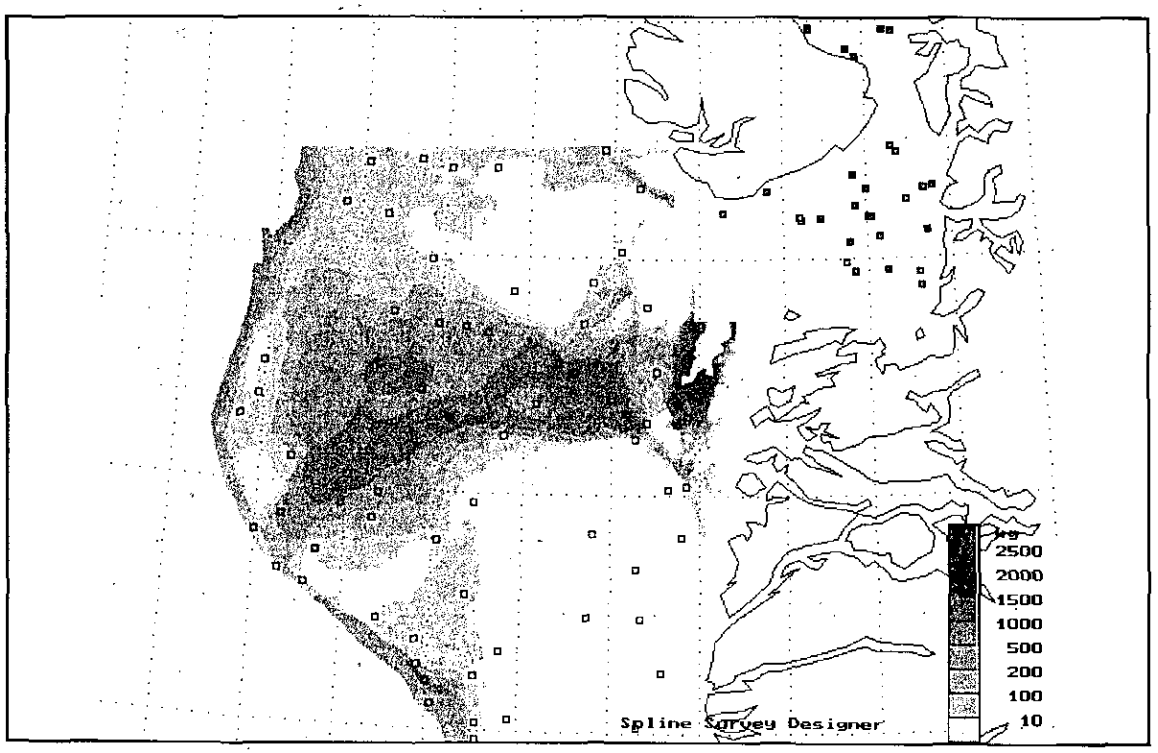


Figure 4b. Conture map with estimated shrimp density for the area 64° N - 67° N, calculated with the 'Spline' method. Sampling sites also given.

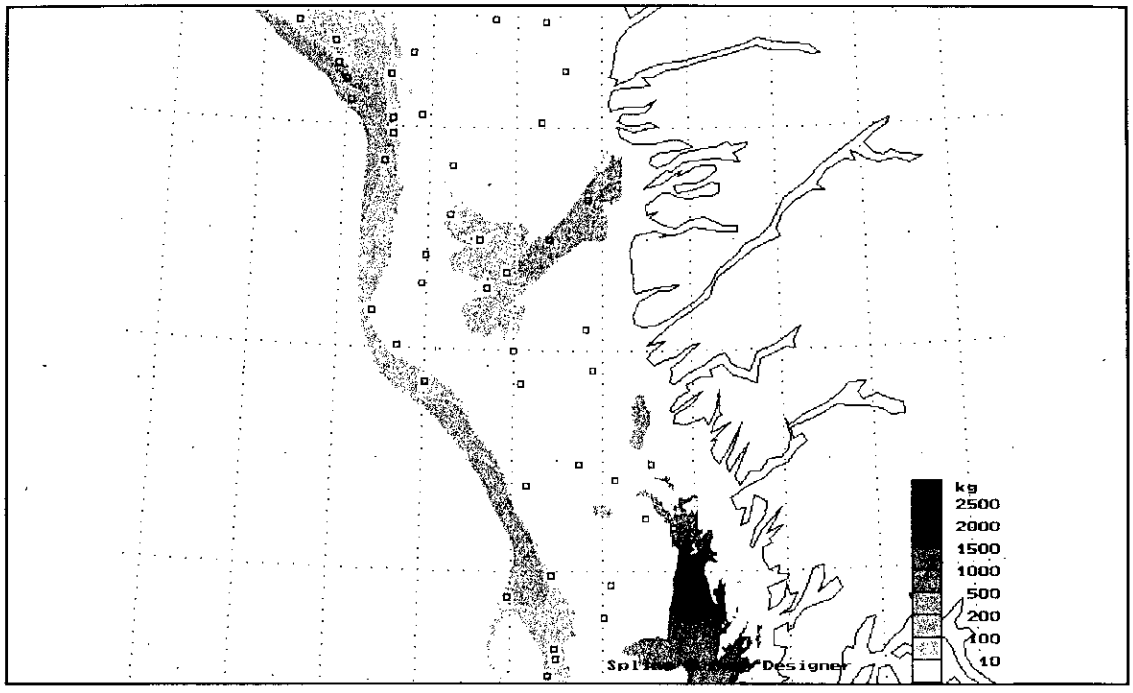
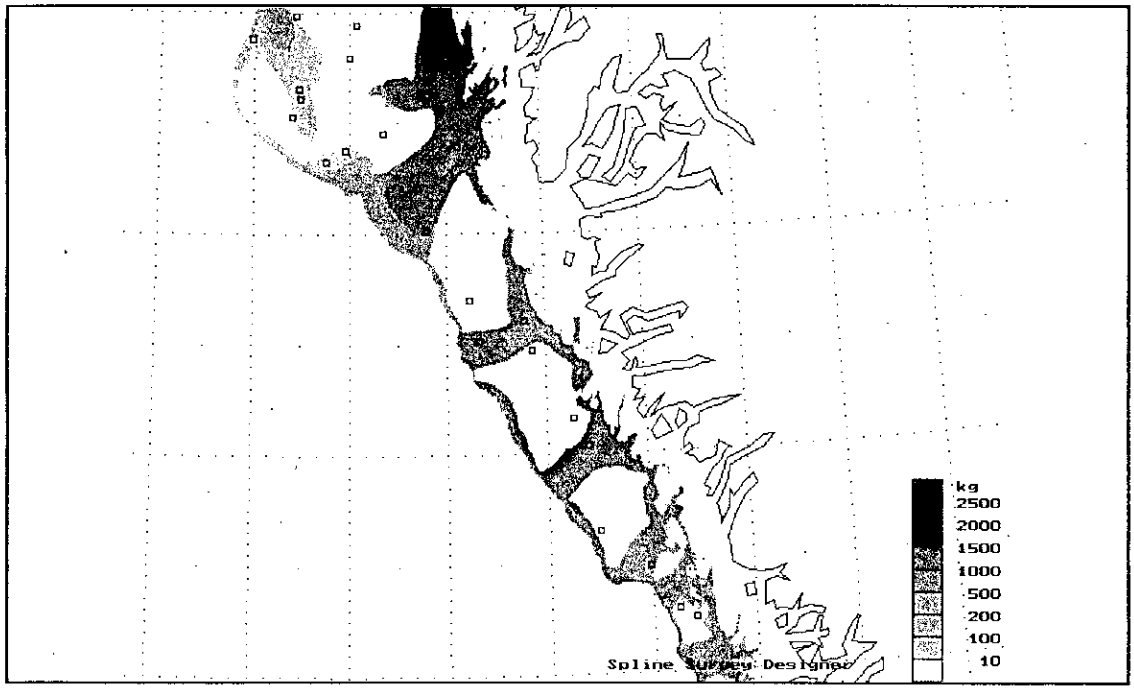


Figure 4c. Conture map with estimated shrimp density for the area 61° N - 64' N, calculated with the 'Spline' method. Sampling sites also given.



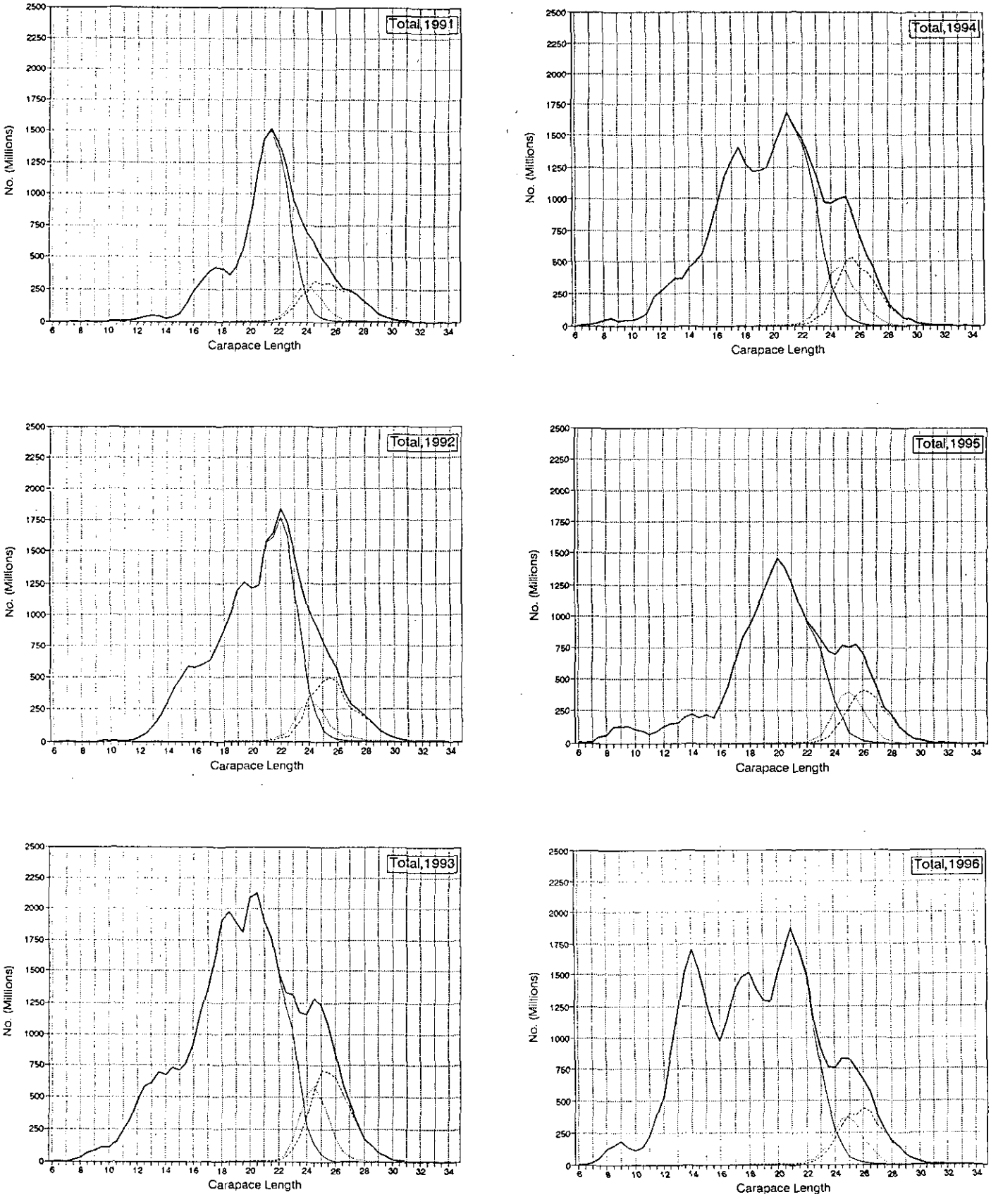


Figure 5. Numbers of shrimp by length group (CL) in total survey area (excluding area S) in 1991-96.

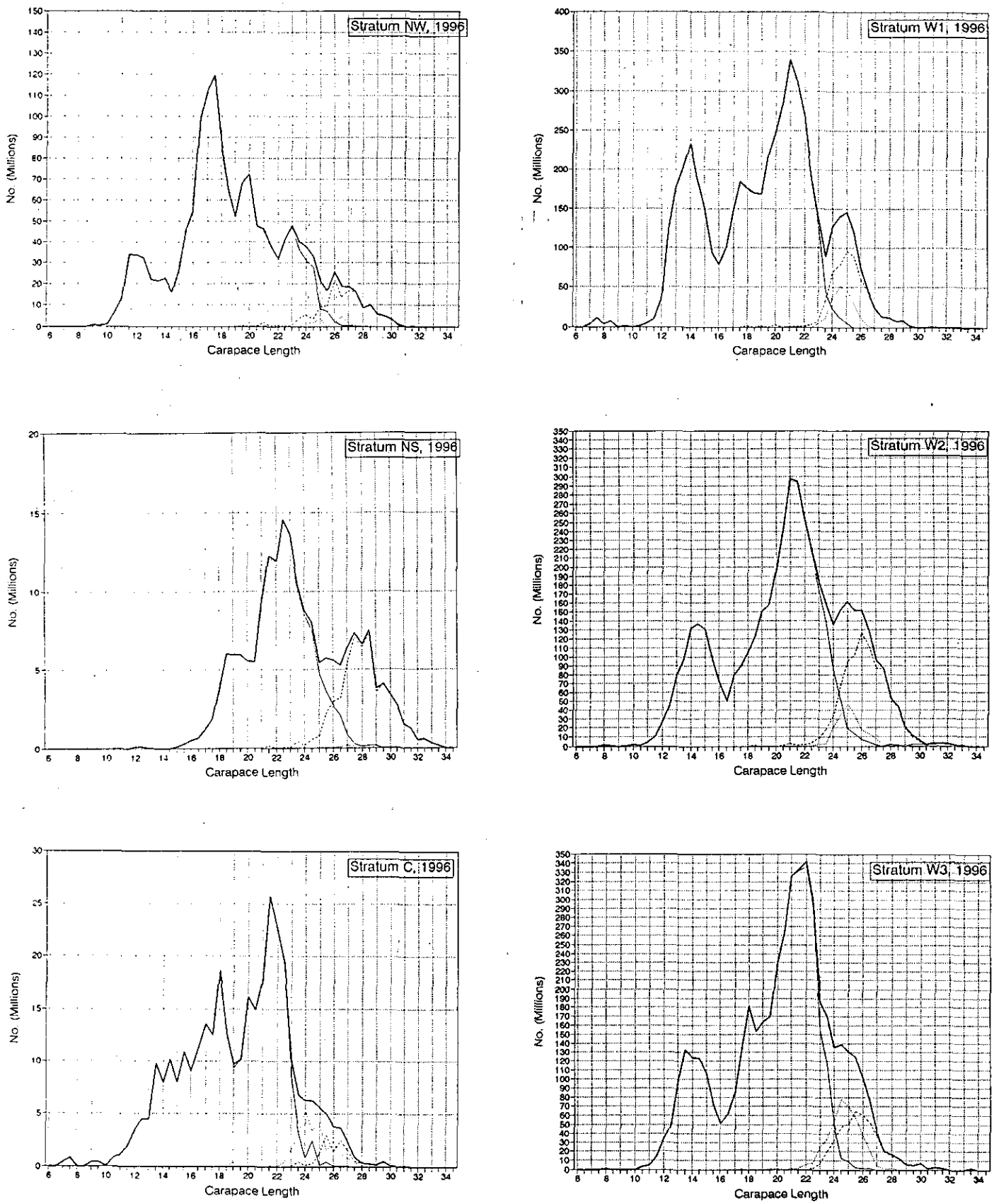


Figure 6a. Numbers of shrimp by length group (CL) in strata NW, NS, C and W1-W3 in 1996.

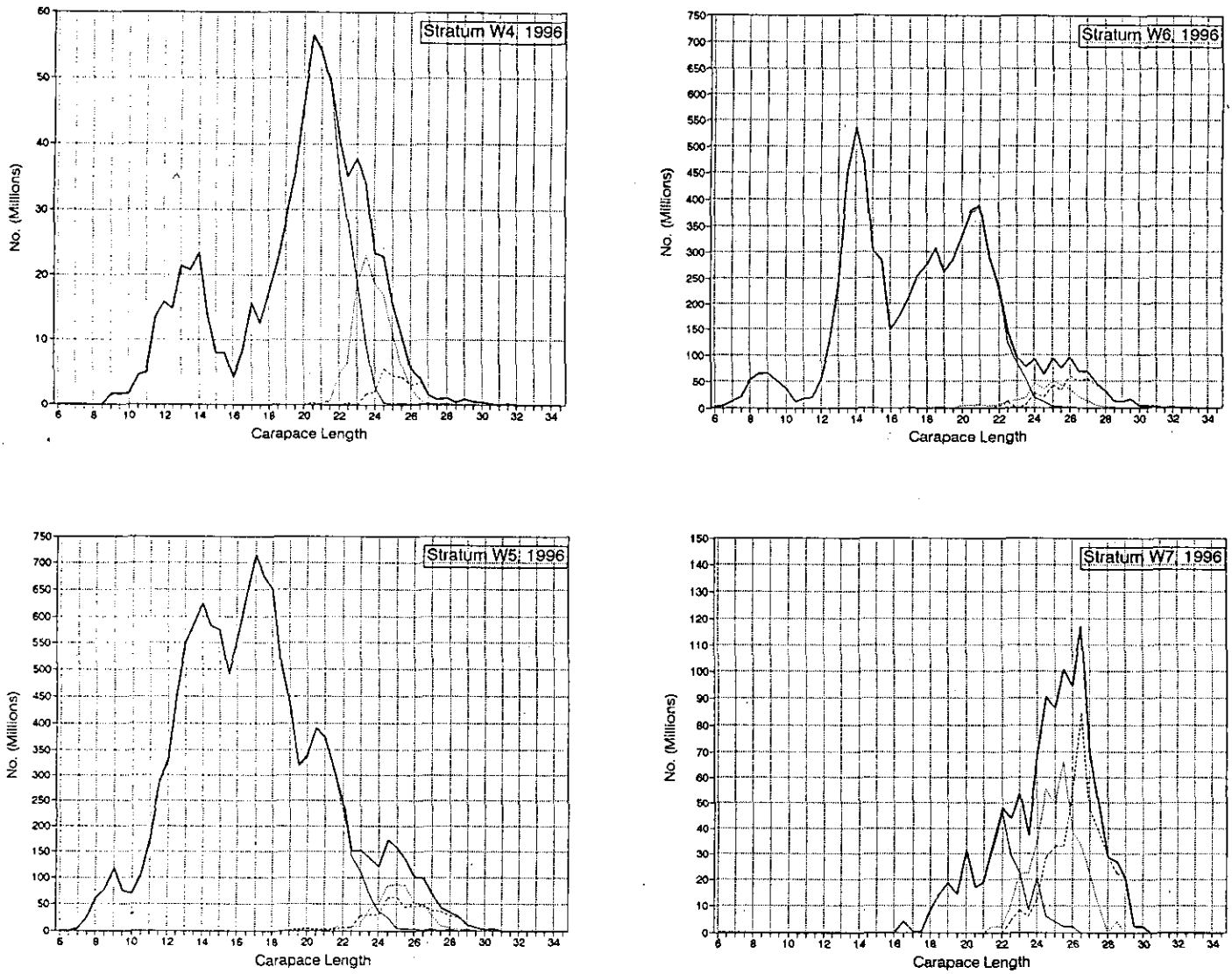


Figure 6b. Numbers of shrimp by length group (CL) in strata W4-W7 in 1996.