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Offshore Trawl Survey for Shrimp (*Pandalus borealis*) in NAFO Subareas 0 and 1, in 1994

by

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Introduction

Greenland Fisheries Research Institute has conducted stratified-random surveys on and around the shrimp fishing grounds off West Greenland since 1988, during the months July - September.

The survey covers offshore areas, down to the 600 meter depth contour, of the southern part of NAFO Div. 1A, NAFO Div. 1B-F, and a small part of south eastern NAFO Div. 0A. The main occurrence of the West Greenland shrimp stock is in the depth interval from 150 to 600 meters, within this area, and the survey is assumed to cover the offshore distribution of the stock.

Materials and Methods

The survey was performed with a 722 GRT trawler, the M/TR "Paamiut", OYZC, using a twin cod-end 3000/20 meshes "SKJERVØY" bottom trawl. Mesh size in the cod-end was 20 mm stretched mesh. Trawl doors were "3.7 GREENLAND PERFECT", measuring 370*250 cm and weighing 2420 kg. Trawl geometry was measured with "SCANMAR" acoustic sensors, mounted on the trawl doors and on the headrope.

To prevent effects of nocturnal vertical migrations, stations were only fished in the time span 0900-1900 UTC. Standard towing time was 60 minutes and towing speed was 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 position of the vessel (GPS) was noted at the beginning and end of each tow.

The mean wingspread was calculated for each haul, based on information on size and type of trawl, trawl doors, warp length, towing speed and distance between doors.

Swept area was calculated as the distance between starting and ending position, multiplied by the mean wingspread.

Stratification within the area of shrimp occurrence is based on the distribution of the commercial fishery. Four regions are defined:

N: The northern region off West Greenland. North of 69°30'N bottom topography is not known well enough to perform depth stratification, so this line is set as the southern limit of the region. Since the onset of the fishery in this area in 1985 a noticeable shift in fishing pattern has taken place. A new stratification between 69°30'N and 71°N was therefore introduced in 1994, reducing the survey area by 2598 km². The northern limit is at 72°30'N and the western at 59°00'W. South of 70°N, however, the area has been extended toward west. The eastern limit is an approximated 3 nm limit line, in 1994 excluding areas west of Disko Island, known to be outside the depth range of shrimp occurrence. The region is divided into nine strata, based on commercial catches in statistical units of 7.5° latitude and 15° longitude. Areas below the 600 meter depth contour are included in the stratum area, but are not fished.

C: The part of the main distributional area that lies within Canadian territorial waters. Two areas (C1, C3) in the same depth interval as in W, and with similar stratification.

W: Together with C, the main area of shrimp distribution. Only the depth interval 150 - 600 meters is included. The region is divided into seven areas, based on distribution of commercial catches and bottom topography. Each of these are further divided into strata, based on depth. Depth strata recognized are: 150-200 meters, 200-300 meters, 300-400 meters, and 400-600 meters.

S: The part of NAFO Div. 1F that lies east of 48°15'W. As is the case in region N, improper sea - charts makes stratification, based on depth, difficult. The region was introduced to the survey in 1992 as area JHB (W8 in 1993), with a stratification in two depth strata. Results from 1992 (Carlsson *et al.*, 1993b) and 1993 (Andersen *et al.*, 1993) indicate that this stratification does not describe abundance well. In 1994 a new stratification was introduced, dividing the depth interval between 150 and 600 meters in the former W8 into to new strata (S1 and S2), based on commercial catches in statistical units of 7.5° latitude and 15° longitude.

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

In area W1-W7 and C the survey was performed as a two-phase stratified random survey, after the guidelines of Francis (1984), allocating extra hauls to strata with high densities, thus reducing the variance of the biomass estimate.

In phase one, hauls were allocated to strata proportionally to the area of these. Strata with a low commercial catch in N (N2, N5, and N8) and S (S2) were only given half the overall coverage. At least two hauls were planned in each stratum.

Phase two was performed after all stations in a stratum were fished. Extra hauls were allocated after the formula:

$$G' = A_i^2 * M_i^2/(n_i * (n_i+1))$$

where

G' is a relative figure for the gain in variance by allocating one extra haul to depth stratum i.

A_i is the area of depth stratum i.

M_i is the average catch per haul in depth stratum i.

n_i is the number of hauls in depth stratum i in phase one.

Stations in phase two were distributed randomly within depth strata with the highest values of G'.

From each haul a sample of approx. 5 kg of shrimp was taken from the codend of the trawl, before it was emptied into the pounder. The shrimp were sorted by sex and the oblique carapax length was measured by slide calliper to the nearest 0.1 mm. The samples were weighted by catch and stratum area to obtain estimates of the total number of shrimp by sex and length group for each stratum and for the total survey area.

The total catch was sorted by species and weighed.

Results and Discussion

Biomass estimates

The 146 successful hauls that were taken in the shrimp strata in the period between July 11th and September 7th are shown in Figure 2. Table 1 lists the stations by stratum and shows the catch in kg of shrimp, cod, Greenland halibut, redfish, and other species combined. The number of hauls and estimated biomass of shrimp per stratum are shown in Table 2.

The total biomass in tons in each of the four regions is shown in the following text table.

Region	Biomass	+/-
N	8473	8223
C	7036	2643
W	162494	51119
S	23183	43066

In table 3 the biomass is shown by region for each year since 1988. Figure 3 shows the biomass by year in groups of strata, not including the two strata in region S, formerly area W8. The total biomass estimate from the 1994 survey is somewhat lower than in 1993, the highest in the survey series, but at the same level as in 1988, 1990, and 1992.

In region N as a whole there is no apparent change from 1993 to 1994, but within the region a shift in the distribution of biomass is seen. Figure 3 shows that more than 50 % of the biomass is concentrated in the southern part of the region. In all previous years the concentration of shrimp in the region has been found in the northern part i.e. north of 71°N. Even if it is likely that some of the apparent shift is caused by one relatively large catch in the supposed low density stratum N5 (station no. 060056, Table 1), it is also evident that the density in the northern parts is reduced to a level not previously encountered.

In region C the biomass has doubled since 1993, and the increase is observed in both strata. The estimate is within the range of the estimates from other years.

In region W there is a decrease in total biomass. The decrease is caused by some reduction in density in W1 and W4 and a significant drop in the to southernmost strata W6 and W7. Only in W3 an increase is observed.

The biomass estimate for region S has decreased approx 30 % since 1993. The high degree of uncertainty (186 %) indicates an estimate that is still unreliable. The estimate depends strongly on a large catch in one haul in the high density stratum.

Table 4 shows that there has been a change in the overall distribution of biomass by depth from 1993 to 1994. The increase in the depth interval 3-400 meters to 68 % of the total biomass, is caused by a reduced abundance in deeper as well as in more shallow strata.

The stock is thus concentrated in a narrow depth range in the northern parts of region W. The low densities in the south, and the increase in west in the northern part of the region, resembles the distribution observed in 1990.

As it is generally believed that shrimp migrate towards north and to greater depth as they grow (Carlsson *et al.*, 1993a), the results indicate lower abundance of large specimens, steady levels of medium sized shrimp, and a recruitment of small shrimp, lower than in 1993.

Stock composition

Number of shrimp in overall length distributions for the survey area (excluding area S) in 1989 to 1994 were:

No. of shrimp (billions)	1989	1990	1991	1992	1993	1994
Males	31.9	21.9	12.2	20.9	31.8	25.0
Females	6.0	8.0	4.4	5.5	7.9	6.4
Total	37.8	29.8	16.6	26.5	39.7	31.4

In accordance with the decrease in biomass from 1993 to 1994, there is a decrease in the total number of shrimp (about 21%). The decrease is of the same size for both males and females.

The number of males found in 1993 and 1994 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.

Overall length distributions of shrimp for the total survey area (excluding area S) in 1989-94 are given in Fig. 5. The overall 1994 distribution shows two dominant modes of males at 17.5 and 21 mm carapace length (CL), assumed to represent the 1990 and 1988 years class, respectively. A small peak at 13 mm CL indicates some incoming recruitment of the 1992 year class. Female modes are found at 24.5 (primiparous) and 25.5 (multiparous) mm CL. The primiparous distribution is assumed to primarily consist of transitioned shrimp from the 1987 year class.

Figures 6a and 6b show length frequencies by stratum in 1994 and yield more information on the occurrence of year classes. The strata north of 69°30'N are combined (stratum NW = N1-N4, NS = N5-N9), as are strata on the Canadian side of the midline (stratum C = C1+C3).

In one of the two areas of concentration of biomass in the northern part of the main survey area (strata W1, W2 and W3) males are dominated by the 1988 and 1990 year classes (at 21.5 and 17.5 mm CL, respectively). Recruitment of the 1992 year class is indicated at 12.5 mm CL. Females are most abundant in stratum W2, with modes at 25.5 and 26.5 mm CL.

In the other area of relatively high shrimp concentrations (stratum W5) a dominating double peak at 20-21 mm CL may represent either the 1988 or the 1989 year class or - more likely - a combination of both. The 1990 year class is less abundant compared to strata W1, W2 and W3. 1991, 1992, and 1993 year classes are indicated with small modes at 14.5, 12, and 8.5 mm CL.

The 1989 year class, which in 1993 was thought to contribute significantly to the male group, especially in the southern strata, seems of less importance compared to the 1988 and 1990 year classes. It may, however, be hidden in the length distributions from the southern areas, where it was prominent in 1993. In the southern stratum W6 the 1989 and the 1991 year classes are found at 19 and 14.5 mm CL, but overall abundance is low.

Benefits of the two phase survey

An important novelty in the 1994 survey is the introduction of a two phase strategy. Attention to the work of Francis (*loc. sit.*) was drawn by D.G. Parsons (pers. com.), and the method seemed well suited for the circumstances prevailing in West Greenland.

The confidence in the biomass estimate for 1994 is somewhat higher than in 1993 (31.4 % compared to 28.7 % in 1993), contradicting the argument for introducing a two phase survey. If calculations of the biomass is performed on stations fished during phase one only, however, the estimate is 221.311 tons +/- 143.413 (64.8 %).

The number of stations allocated to region W in phase one (87) is close to the number in previous years (84 in 1993), giving the same coverage in all strata. The biomass estimate for 1994 would have been most unreliable without the 14 extra hauls, taken during phase two.

The method not only allocates extra hauls to strata with high densities, but takes into account the area of those strata - hence the impact on the estimate for the total area. It thus seems that the two phase survey was introduced in a year when the distribution of the stock was well suited for exemplifying the benefits.

References

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Table 1a. List of trawl stations in strata west of the midline, and north of 69°30'N in the Davis Strait survey, July-August 1994. Catches are given in kg.

STATION-IDENTIFICATION	AREA-CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM C1-3									
94PA0060021 103	KX436	324.5	60	33	0	3	17	21	74
94PA0060018 113	LA436	332.0	60	282	0	4	39	64	389
STRATUM C1-4									
94PA0060020 105	KX435	483.0	60	75	0	8	52	45	179
94PA0060019 111	KZ435	433.5	60	40	1	34	143	46	263
STRATUM C3-2									
94PA0060007 087	KP440	276.5	60	25	0	0	11	10	47
94PA0060023 094	KS437	282.5	47	189	0	9	43	41	282
STRATUM C3-3									
94PA0060008 090	KP438	361.0	60	392	0	10	184	47	633
94PA0060013 101	KV438	309.0	60	237	0	8	74	52	371
STRATUM C3-4									
94PA0060009 089	KP437	442.5	59	52	0	14	111	21	198
94PA0060022 098	KV435	473.5	60	21	0	12	41	23	97
STRATUM N1									
94PA0060047 169	ML002	265.5	60	0	0	2	0	31	33
94PA0060048 167	ML007	253.5	60	0	0	1	2	20	23
94PA0060046 170	MM001	325.0	60	1	0	1	0	51	53
94PA0060045 171	MN004	349.5	60	123	0	12	0	375	510
94PA0060044 172	MN439	304.5	60	0	0	0	0	64	64
STRATUM N2									
94PA0060055 161	ME004	227.5	30	0	0	0	0	2	2
94PA0060049 164	MG004	237.5	60	0	0	0	0	7	7
94PA0060042 166	MJ001	244.5	60	0	0	0	0	0	0
94PA0060043 168	MK439	330.5	60	0	0	0	0	15	15
STRATUM N3									
94PA0060051 162	MF007	279.0	60	0	0	1	0	31	32
94PA0060050 163	MG007	246.0	60	0	0	0	0	27	28
STRATUM N4									
94PA0060054 159	MB003	331.5	60	0	0	0	0	0	0
94PA0060053 160	MB005	343.5	32	0	0	1	0	11	12
94PA0060052 158	MB010	423.5	60	255	0	43	4	74	376
STRATUM N5									
94PA0060060 156	LX006	510.5	60	1	0	6	1	5	13
94PA0060056 157	LZ001	458.5	60	106	0	20	2	43	170
STRATUM N6									
94PA0060059 151	LT001	441.5	60	54	0	11	9	41	115
94PA0060058 150	LT440	425.5	32	28	0	3	4	13	48
94PA0060061 155	LX008	480.5	60	3	0	4	6	10	23
94PA0060057 154	LX440	502.0	60	4	0	8	15	3	30
STRATUM N7									
94PA0060062 152	LV008	217.0	30	0	0	0	0	0	0
94PA0060063 153	LV010	196.5	60	0	0	0	1	7	8
STRATUM N8									
94PA0070005 144	LK009	214.0	60	0	0	0	0	92	92
94PA0070003 148	LN004	194.0	48	0	0	0	0	22	22
94PA0060041 149	LN437	290.5	60	16	0	2	3	24	45
STRATUM N9									
94PA0070001 146	LK438	435.0	60	3	0	1	35	32	70
94PA0060040 147	LM437	308.0	60	42	0	0	3	27	72
94PA0070002 145	LM439	325.5	60	0	0	0	1	11	12

Table 1b. List of trawl stations in strata between 67°00'N and 69°30'N, east of the midline in the Davis Strait survey, July-August 1994. Catches are given in kg.

STATION-IDENTIFICATION	AREA-CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM W1-1									
94PA0070010 133	LG008	162.5	61	0	0	0	0	0	0
94PA0070009 135	LG009	159.5	60	0	0	0	0	2	2
94PA0070006 142	LJ009	186.0	60	0	0	0	0	7	7
STRATUM W1-2									
94PA0050056 129	LD005	246.0	60	207	0	2	5	60	274
94PA0060025 130	LF003	262.5	60	12	0	3	3	35	53
94PA0070011 137	LH003	222.0	60	0	0	0	0	2	2
94PA0060034 138	LH440	274.5	50	0	0	1	0	22	24
94PA0060026 140	LJ005	211.5	30	0	0	0	0	9	9
94PA0070004 141	LJ007	212.5	60	0	0	1	0	42	42
94PA0070007 143	LJ012	259.5	60	8	0	4	0	38	50
STRATUM W1-3									
94PA0060012 104	KX440	327.0	60	589	0	37	68	38	732
94PA0050049 114	LA002	343.0	60	639	0	67	75	18	798
94PA0050059 118	LA007	354.0	60	883	0	41	91	14	1028
94PA0060014 115	LA438	321.0	60	29	0	7	82	67	185
94PA0050050 117	LA440	311.5	60	456	0	26	19	49	550
94PA0050058 121	LB007	337.0	60	965	0	34	9	54	1061
94PA0060015 123	LB440	333.5	60	319	0	17	23	33	391
94PA0050057 127	LD005	315.5	60	692	0	77	20	33	821
94PA0060017 125	LD437	340.5	62	127	0	5	42	65	239
94PA0060016 124	LD438	333.0	61	184	0	5	33	50	273
94PA0060039 206	LE439	329.5	60	32	0	10	14	39	94
94PA0060037 131	LF438	373.5	60	48	0	7	44	27	125
94PA0060035 136	LG439	311.5	39	15	0	1	0	10	27
STRATUM W1-4									
94PA0060038 132	LF437	447.5	60	2	0	8	122	31	163
94PA0060036 139	LH438	503.5	60	1	0	10	159	16	185
STRATUM W2-1									
94PA0050051 126	LD015	156.5	60	0	0	0	3	27	29
94PA0070008 134	LF011	157.5	60	0	0	0	0	0	0
STRATUM W2-2									
94PA0060028 110	KZ014	263.0	60	1	0	0	0	4	6
94PA0050054 119	LA011	247.0	60	31	0	3	3	45	81
94PA0050053 122	LB012	240.5	60	4	0	2	6	31	43
94PA0050052 120	LB014	250.0	60	899	0	10	11	58	978
STRATUM W2-3									
94PA0070045 907	KT016	341.5	60	98	0	3	3	24	128
94PA0060029 109	KX014	323.5	60	289	0	1	17	24	331
94PA0060030 107	KX016	366.5	60	4594	0	3	70	207	4873
94PA0070044 909	KZ013	360.0	60	578	0	64	11	23	675
94PA0050055 202	LA009	370.5	60	959	0	59	27	10	1055
94PA0070043 901	LA011	352.5	60	948	0	28	18	67	1060
94PA0060032 204	LB013	368.0	30	97	0	2	9	8	116
94PA0060033 205	LB015	311.0	60	976	0	2	3	59	1039
94PA0070042 903	LD013	348.0	60	1040	0	66	22	236	1363
STRATUM W2-4									
94PA0060031 106	KX016	446.5	60	161	0	17	17	31	226
94PA0060027 116	LA016	544.0	60	357	0	106	11	39	513
STRATUM W3-1									
94PA0050042 077	KJ007	158.5	60	0	0	0	2	16	18
94PA0050046 092	KR007	169.0	60	0	0	0	0	115	115
94PA0050047 096	KT006	170.5	60	0	0	0	0	16	17
STRATUM W3-2									
94PA0050041 080	KK006	247.5	60	9	0	0	6	12	27
94PA0060005 084	KM003	224.0	60	1	0	0	0	4	5
94PA0060006 086	KN001	235.0	60	0	0	0	0	0	0
94PA0050044 088	KP005	208.5	60	0	0	0	0	8	8
94PA0050045 091	KR004	222.0	60	0	0	1	2	13	16
94PA0050062 099	KV006	239.0	60	32	0	1	3	7	43
STRATUM W3-3									
94PA0050040 079	KK005	323.5	60	1201	0	4	147	30	1382
94PA0070051 905	KS002	346.0	61	1186	0	12	3	25	1226
94PA0060010 093	KS440	329.0	60	1418	0	7	309	38	1771
94PA0070048 906	KT001	383.5	60	840	0	42	100	22	1004
94PA0060024 203	KT003	333.0	60	943	0	7	690	66	1705
94PA0070049 902	KT003	341.5	61	1005	0	14	91	43	1154
94PA0070050 908	KT003	332.0	60	269	0	0	0	14	283
94PA0050063 102	KV004	317.0	60	705	0	8	97	33	843
94PA0070047 904	KV440	316.0	60	317	0	6	10	87	420
STRATUM W3-4									
94PA0050039 075	KJ005	474.0	60	8	0	40	581	18	648
94PA0060011 100	KV001	430.5	60	244	0	53	69	14	380
94PA0050061 108	KX008	478.0	60	228	0	67	92	8	395
94PA0050060 112	KZ010	465.5	60	288	0	34	24	23	369

Table 1c. List of trawl stations in strata between 59°30'N and 67°00'N in the Davis Strait survey, July-August 1994. Catches are given in kg.

STATION-IDENTIFICATION	AREA-CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM W4-1									
94PA0050030 063	KA012	181.5	60	2	0	2	17	8	28
94PA0050034 064	KB009	163.0	60	0	1	0	5	19	25
94PA0050036 068	KE007	185.0	60	0	0	0	1	6	7
94PA0050035 066	KE011	172.0	60	0	0	0	0	6	6
94PA0050038 072	KG008	169.5	60	0	0	0	2	15	18
STRATUM W4-2									
94PA0050032 058	JX009	269.0	60	97	0	0	8	20	125
94PA0050031 062	KA011	219.5	60	4	0	4	6	10	24
STRATUM W4-3									
94PA0050027 067	KE015	346.5	60	795	0	35	16	66	911
94PA0050037 070	KF007	313.0	60	105	0	8	144	19	276
STRATUM W4-4									
94PA0050033 061	KA007	437.5	60	358	0	12	63	15	448
94PA0050028 071	KF017	439.5	60	82	0	72	18	46	218
STRATUM W5-1									
94PA0050017 043	JJ019	172.5	60	0	0	0	0	3	3
94PA0050023 056	JV010	178.0	60	0	0	0	0	1	1
STRATUM W5-2									
94PA0050014 039	JD019	278.5	60	884	0	0	52	7	943
94PA0050018 042	JH015	269.0	60	99	0	1	41	7	147
94PA0050020 046	JK013	294.0	60	10	0	0	107	8	125
STRATUM W5-3									
94PA0050019 041	JJ012	341.5	60	1	0	0	52	12	65
94PA0050001 047	JL020	340.5	50	844	2	14	45	16	920
STRATUM W5-4									
94PA0050015 040	JG021	525.0	60	423	0	110	23	44	599
94PA0050002 044	JK020	444.5	60	142	2	35	18	10	206
94PA0050021 049	JM013	529.5	60	2	0	3	20	5	30
94PA0050022 053	JS011	557.5	60	36	0	20	31	15	103
STRATUM W6-1									
94PA0050008 026	HH030	177.0	60	4	0	0	0	4	8
94PA0050005 034	HR023	190.5	60	1	0	0	3	20	24
STRATUM W6-2									
94PA0050007 024	HF030	245.0	60	0	0	0	9	13	22
94PA0050011 030	HL028	225.0	60	1227	0	10	4	210	1451
94PA0050013 201	HR023	239.0	60	1	0	0	15	5	21
STRATUM W6-3									
94PA0050009 029	HK029	318.5	50	18	0	1	16	6	41
94PA0050003 037	HX022	341.5	60	217	0	1	40	12	271
STRATUM W6-4									
94PA0050010 028	HK028	419.5	30	0	0	0	0	0	0
94PA0050012 032	HN025	417.0	60	0	0	0	0	0	0
STRATUM W7-1									
94PA0080007 019	HA032	156.5	30	0	0	0	0	0	0
94PA0080005 022	HB032	180.0	34	15	0	0	0	2	18
STRATUM W7-2									
94PA0080009 016	GP037	215.5	67	0	0	0	0	0	0
94PA0080006 021	HA031	213.5	54	0	0	0	0	183	184
STRATUM W7-3									
94PA0080010 015	GP038	358.0	31	0	0	0	0	0	0
94PA0080008 018	GX033	332.0	60	0	0	0	0	1	1
STRATUM W7-4									
94PA0080004 023	HD030	462.5	60	0	0	0	0	5	5
STRATUM S1									
94PA0080014 007	GL044	316.0	60	4	0	0	0	54	59
94PA0080015 009	GM044	269.5	60	2673	0	2	65	32	2771
94PA0080016 011	GN046	448.0	50	2	0	0	3	2	7
94PA0080017 014	GN047	446.0	43	3	0	0	0	2	5
STRATUM S2									
94PA0080012 008	GM040	168.0	60	1	0	0	0	14	15
94PA0080013 012	GN041	159.5	60	78	0	0	1	8	86

Table 2a. Estimated trawlable biomass in strata west of the midline in the Davis Strait survey July-August 1994.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA C1 300-400 M	655	1024.4	2	1134.0	801.9	223	1826
AREA C1 400-600 M	312	213.0	2	113.8	80.5	133	293
AREA C3 200-300 M	660	944.3	2	1070.4	756.9	187	1701
AREA C3 300-400 M	1192	4601.3	2	1006.2	711.5	3890	5313
AREA C3 400-600 M	623	253.5	2	186.6	131.9	122	385

Table 2b. Estimated trawlable biomass in strata north of 69°30'N in the Davis Strait survey July-August 1994.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA N1	3664	959.8	5	2121.6	948.8	0	4755
AREA N2	11740	0.0	4	0.0	0.0	0	0
AREA N3	368	0.3	2	0.5	0.3	0	1
AREA N4	2257	2325.2	3	4027.4	2325.2	0	6976
AREA N5	5766	3222.5	2	4456.5	3151.2	71	6374
AREA N6	3237	1049.0	4	1061.1	530.6	123	2007
AREA N7	1029	2.1	2	2.9	2.1	0	4
AREA N8	8063	485.0	3	840.0	485.0	0	1455
AREA N9	2407	428.8	3	671.8	387.8	3	1203

Table 2c. Estimated trawlable biomass in strata south of 69°30'N east of the midline (areas W1-W7) in the Davis Strait survey July-August 1994.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA W1 150-200 M	2416	0.0	3	0.0	0.0	0	0
AREA W1 200-300 M	5295	1998.1	7	4729.0	1787.4	0	12699
AREA W1 300-400 M	9239	36614.8	13	32541.4	9025.4	2301	93501
AREA W1 400-600 M	752	12.3	2	8.0	5.6	7	18
AREA W2 150-200 M	1857	0.0	2	0.0	0.0	0	0
AREA W2 200-300 M	3026	7192.8	4	13741.2	6870.6	39	27798
AREA W2 300-400 M	2158	30260.1	9	43750.2	14583.4	2630	144686
AREA W2 400-600 M	1723	5034.9	2	2732.0	1931.8	3103	6967
AREA W3 150-200 M	2215	0.0	3	0.0	0.0	0	0
AREA W3 200-300 M	4810	456.6	6	850.9	347.4	0	2132
AREA W3 300-400 M	2714	26921.1	9	12720.0	4240.0	8468	44156
AREA W3 400-600 M	3361	7444.7	4	4781.4	2390.7	276	10034
AREA W4 150-200 M	4252	20.9	5	46.8	20.9	0	105
AREA W4 200-300 M	1791	1049.0	2	1386.9	980.7	68	2030
AREA W4 300-400 M	812	3534.5	2	3227.3	2282.1	1252	5817
AREA W4 400-600 M	1967	5756.0	2	4573.7	3234.1	2522	8990
AREA W5 150-200 M	1995	0.0	2	0.0	0.0	0	0
AREA W5 200-300 M	3454	13261.4	3	18489.4	10674.8	286	34432
AREA W5 300-400 M	1797	10354.5	2	14614.9	10334.3	20	20689
AREA W5 400-600 M	2806	4220.0	4	4964.7	2482.3	63	11064
AREA W6 150-200 M	1095	34.0	2	36.0	25.5	8	59
AREA W6 200-300 M	1491	5907.2	3	10222.9	5902.2	0	17712
AREA W6 300-400 M	1300	1926.1	2	2279.8	1612.0	314	3538
AREA W6 400-600 M	884	0.0	2	0.0	0.0	0	0
AREA W7 150-200 M	2419	493.6	2	698.1	493.6	0	987
AREA W7 200-300 M	985	1.4	2	2.0	1.4	0	3
AREA W7 300-400 M	239	0.3	2	0.4	0.3	0	1
AREA W7 400-600 M	273	0.0	1	.	.	0	0

Table 2d. Estimated trawlable biomass in strata In South Greenland (Julianehaab Bay) in the Davis Strait survey July-August 1994.

STRATUM	SQKM	BIOMASS IN STRATA					
		TONS	HAULS	STD	STDERR	MIN	MAX
AREA S1	1993	21572.2	4	42872.8	21436.4	61	85881
AREA S2	3198	2110.6	2	2881.3	2038.1	73	4149

Table 3. Sums of estimated biomasses in main regions 1988-94 (region 'South' excluded).

AREA	BIOMASS IN YEAR						
	1988	1989	1990	1991	1992	1993	1994
WEST	140332	176525	151402	108406	141158	211966	162495
CANADA	9305	3836	11425	4668	16764	3609	7036
NORTH	21901	11342	11733	6032	21164	9057	8473
TOTAL	171538	191703	174560	119106	179089	224632	178004

Table 4. Relative distribution (%) of estimated biomasses 1988-94 in depth strata south of 69°30'N (regions C and W).

YEAR	DEPTH STRATUM			
	150-200	200-300	300-400	400-600
1988	8.9	28.0	49.9	13.2
1989	5.3	55.6	32.1	7.0
1990	0.3	25.8	58.8	15.1
1991	0.5	19.9	60.6	19.0
1992	2.4	22.6	62.2	12.8
1993	0.0	23.5	58.4	18.1
1994	0.3	18.2	68.0	13.5

Table 5. Numbers of shrimp (thousands) per length group (CL) in total biomass estimate in 1994, based on pooling of individual samples weighted by catch and stratum area.

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Table 5. Number of shrimp (millions) per length group (CL) in total biomass estimate in 1994, based on pooling of individual samples weighted by catch and stratum area.

CL	Males	Prim.fem.	Mul.fem.	Total
6.5	5.2	0.0	0.0	5.2
7.0	10.4	0.0	0.0	10.4
7.5	23.1	0.0	0.0	23.1
8.0	44.7	0.0	0.0	44.7
8.5	56.2	0.0	0.0	56.2
9.0	36.4	0.0	0.0	36.4
9.5	43.3	0.0	0.0	43.3
10.0	44.4	0.0	0.0	44.4
10.5	66.4	0.0	0.0	66.4
11.0	96.9	0.0	0.0	96.9
11.5	226.4	0.0	0.0	226.4
12.0	271.5	0.0	0.0	271.5
12.5	321.1	0.0	0.0	321.1
13.0	376.3	0.0	0.0	376.3
13.5	366.7	0.0	0.0	366.7
14.0	453.0	0.0	0.0	453.0
14.5	496.3	0.0	0.0	496.3
15.0	569.0	0.0	0.0	569.0
15.5	752.9	0.0	0.0	752.9
16.0	951.1	0.0	0.0	951.1
16.5	1176.1	0.0	0.0	1176.1
17.0	1308.1	0.0	0.0	1308.1
17.5	1403.2	1.6	0.0	1404.8
18.0	1273.8	1.5	0.0	1275.3
18.5	1217.9	0.0	0.0	1217.9
19.0	1217.9	3.6	0.7	1222.2
19.5	1244.0	1.5	0.4	1245.9
20.0	1389.0	1.2	1.8	1392.1
20.5	1528.0	3.4	2.3	1533.7
21.0	1683.5	4.4	0.1	1688.0
21.5	1551.9	4.3	5.8	1562.0
22.0	1427.5	29.9	11.7	1469.1
22.5	1218.6	65.9	24.7	1309.2
23.0	936.4	160.5	66.3	1163.1
23.5	593.8	276.9	97.4	968.2
24.0	321.3	404.9	234.9	961.1
24.5	183.2	452.1	357.5	992.7
25.0	83.0	425.3	501.3	1009.5
25.5	44.9	301.5	532.0	878.3
26.0	20.8	245.3	447.8	714.0
26.5	6.6	132.0	418.8	557.4
27.0	2.4	88.3	351.2	441.8
27.5	1.1	45.3	247.8	294.2
28.0	1.4	19.1	142.9	163.4
28.5	0.0	8.7	107.1	115.8
29.0	0.0	2.6	59.2	61.8
29.5	0.0	0.4	50.5	50.9
30.0	0.0	0.1	21.4	21.5
30.5	0.0	0.2	14.9	15.1
31.0	0.0	0.0	7.9	8.0
31.5	0.0	0.0	2.4	2.4
32.0	0.0	0.0	0.8	0.8
32.5	0.0	0.0	0.2	0.2
Total	25045.6	2680.3	3709.8	31435.7

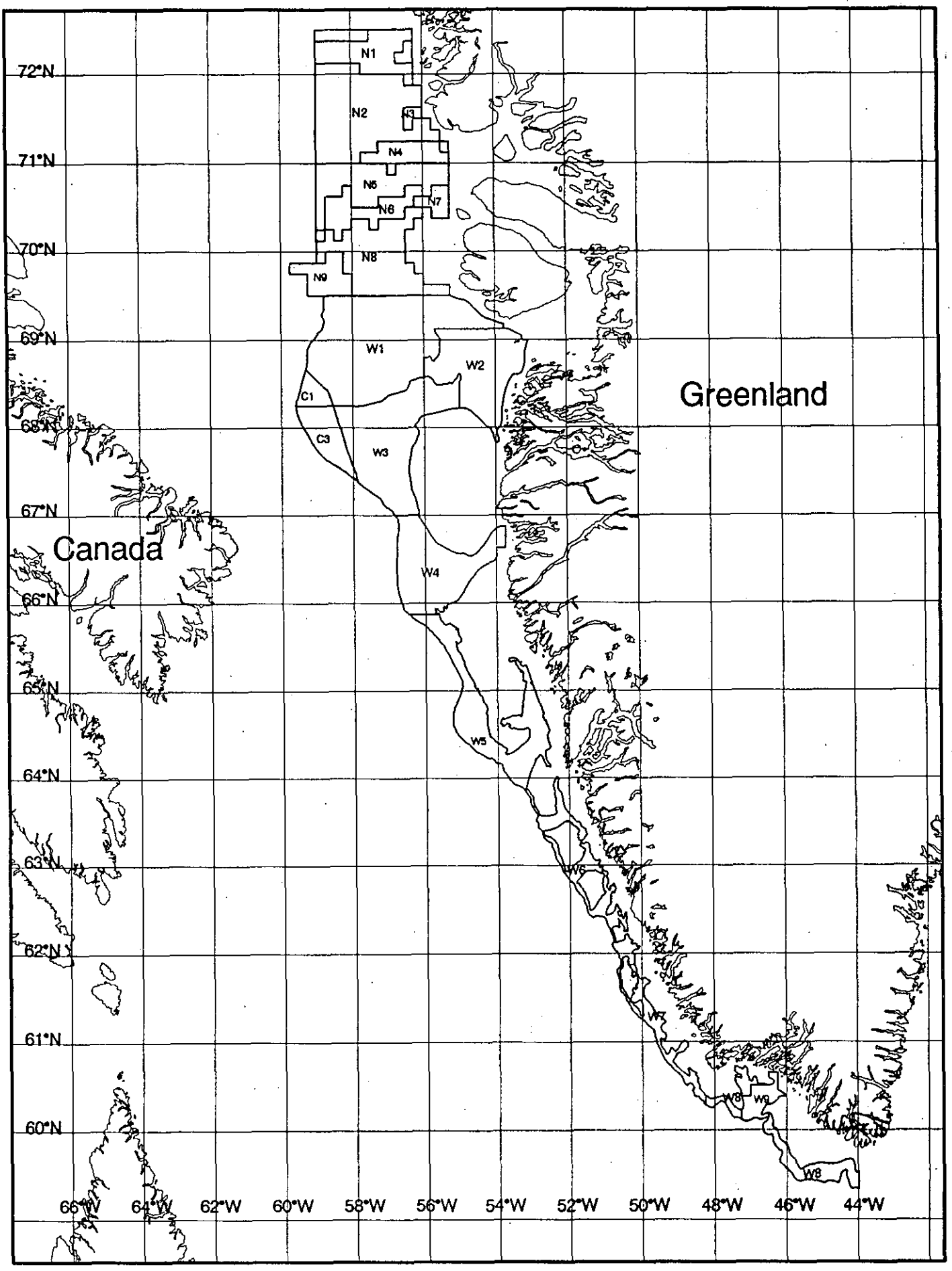

Figure 1. Stratification scheme for the West Greenland offshore shrimp surveys showing stratum numbering as used in the text.

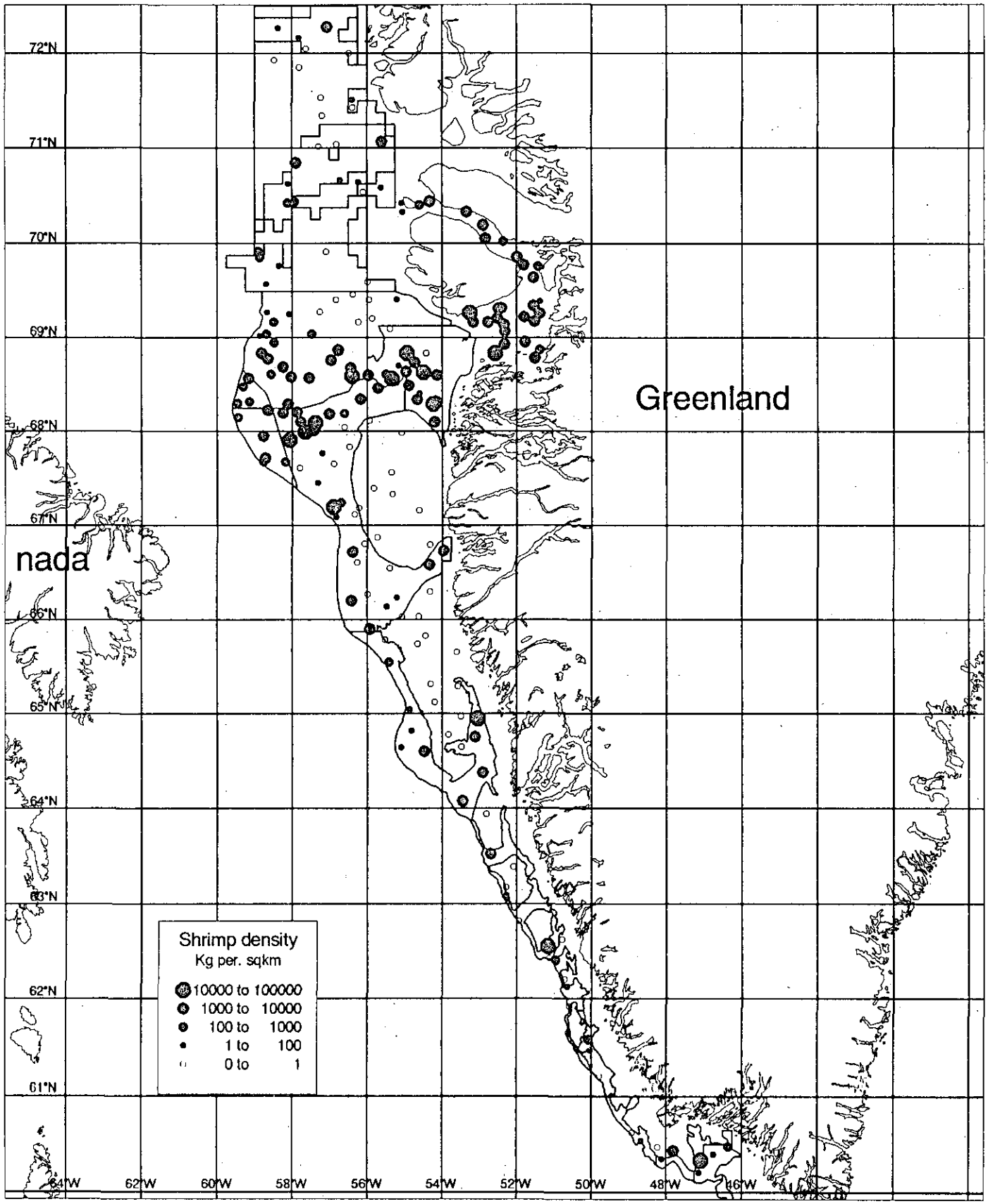

Figure 2. Sampling sites and catch of shrimp (per km²) in the West Greenland offshore shrimp survey in 1994.

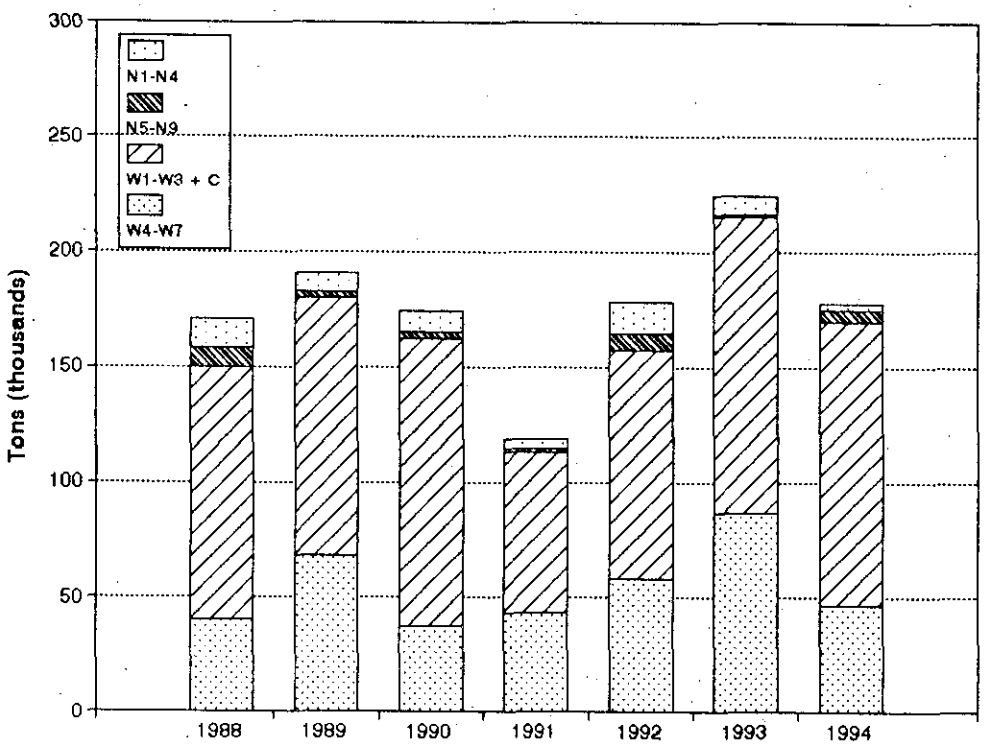

Figure 3. Estimated total biomass 1988-94 for groups of strata in Davis Strait.

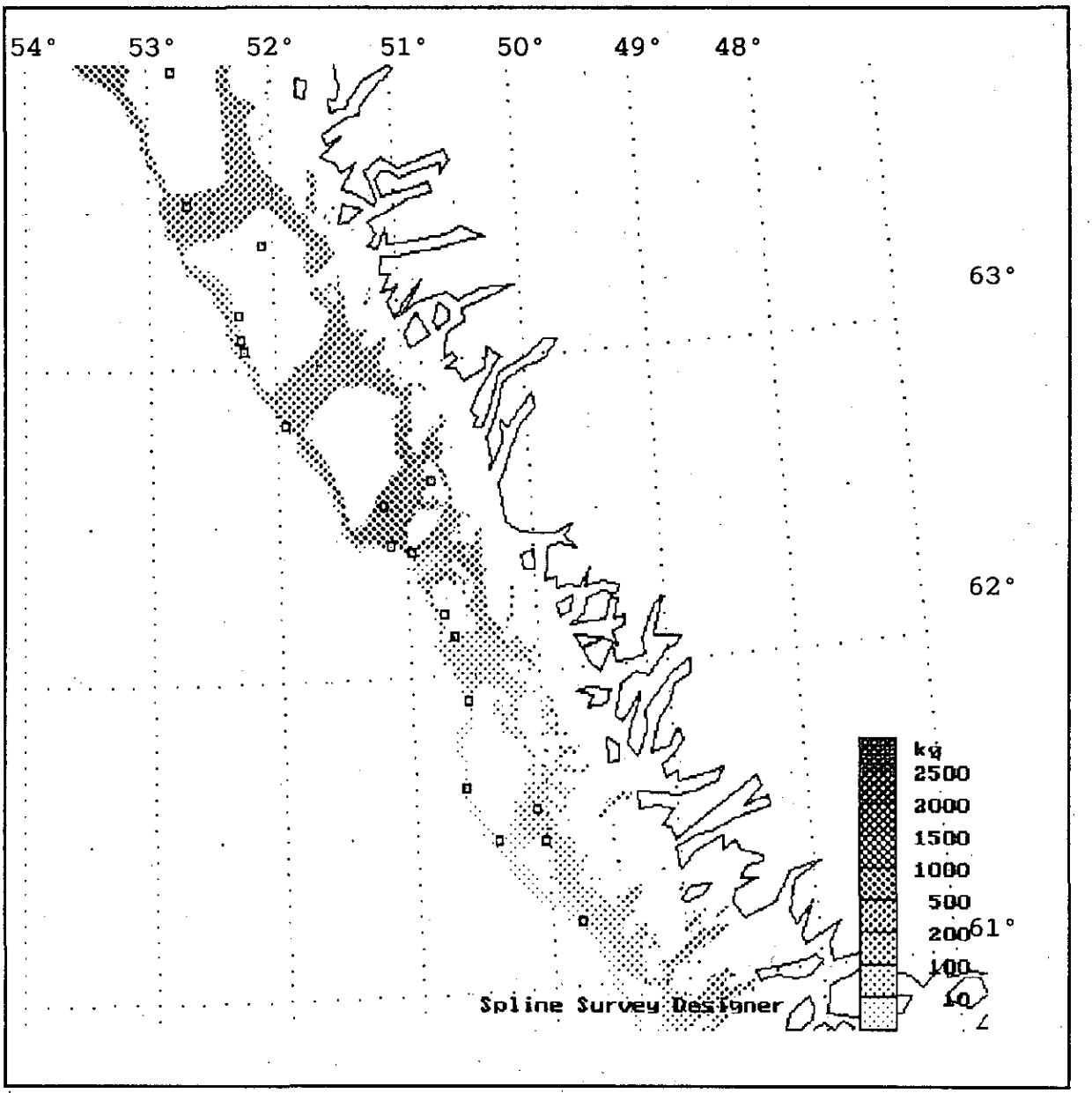

Figure 4a. Contour map with estimated shrimp densities 1994 for the area 61°N-64°N as calculated with the 'spline' method, based on survey data. Sampling sites are also given.

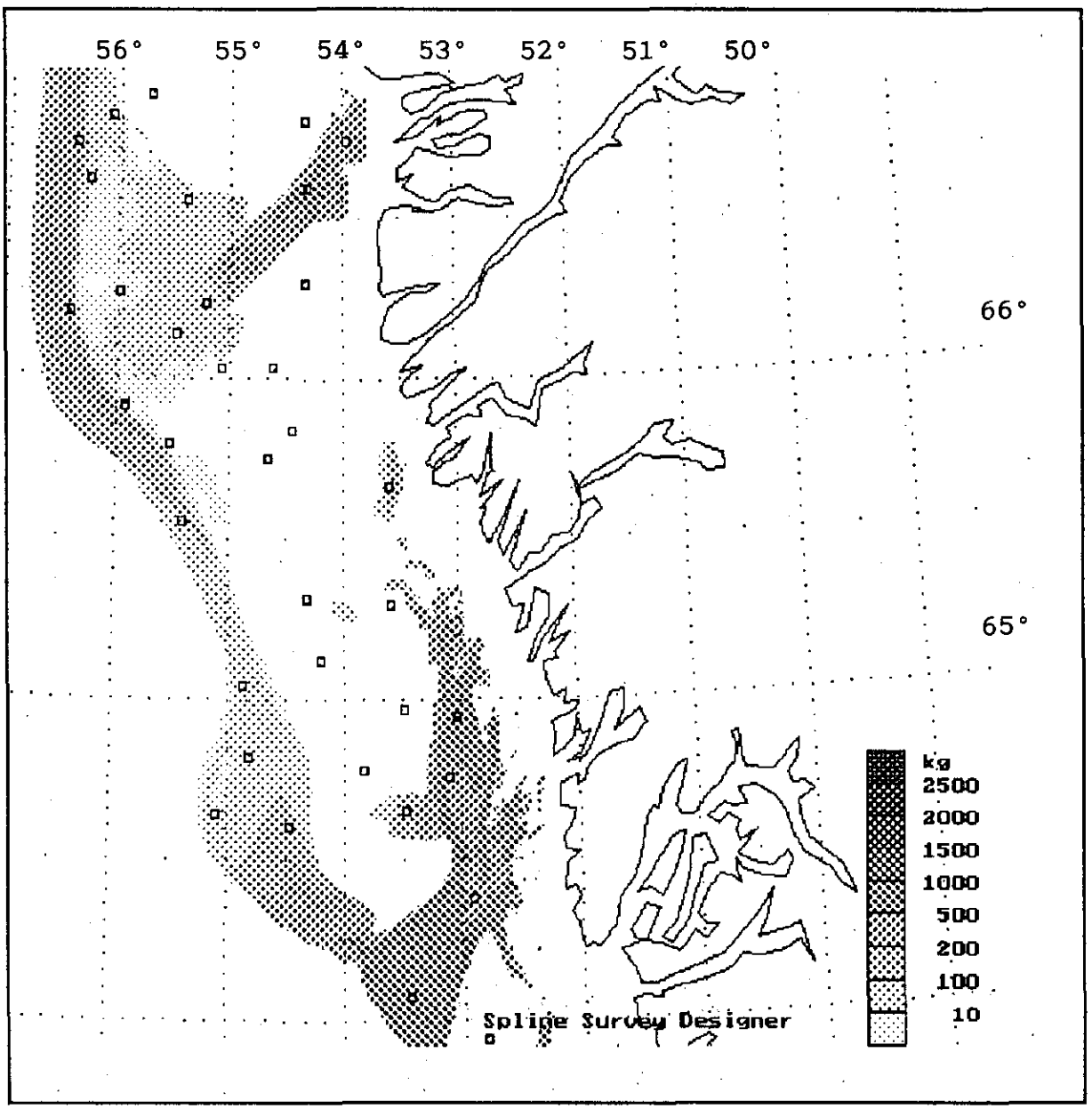

Figure 4b. Contour map with estimated shrimp densities 1994 for the area 64°N-67°N as calculated with the 'spline' method, based on survey data. Sampling sites are also given.

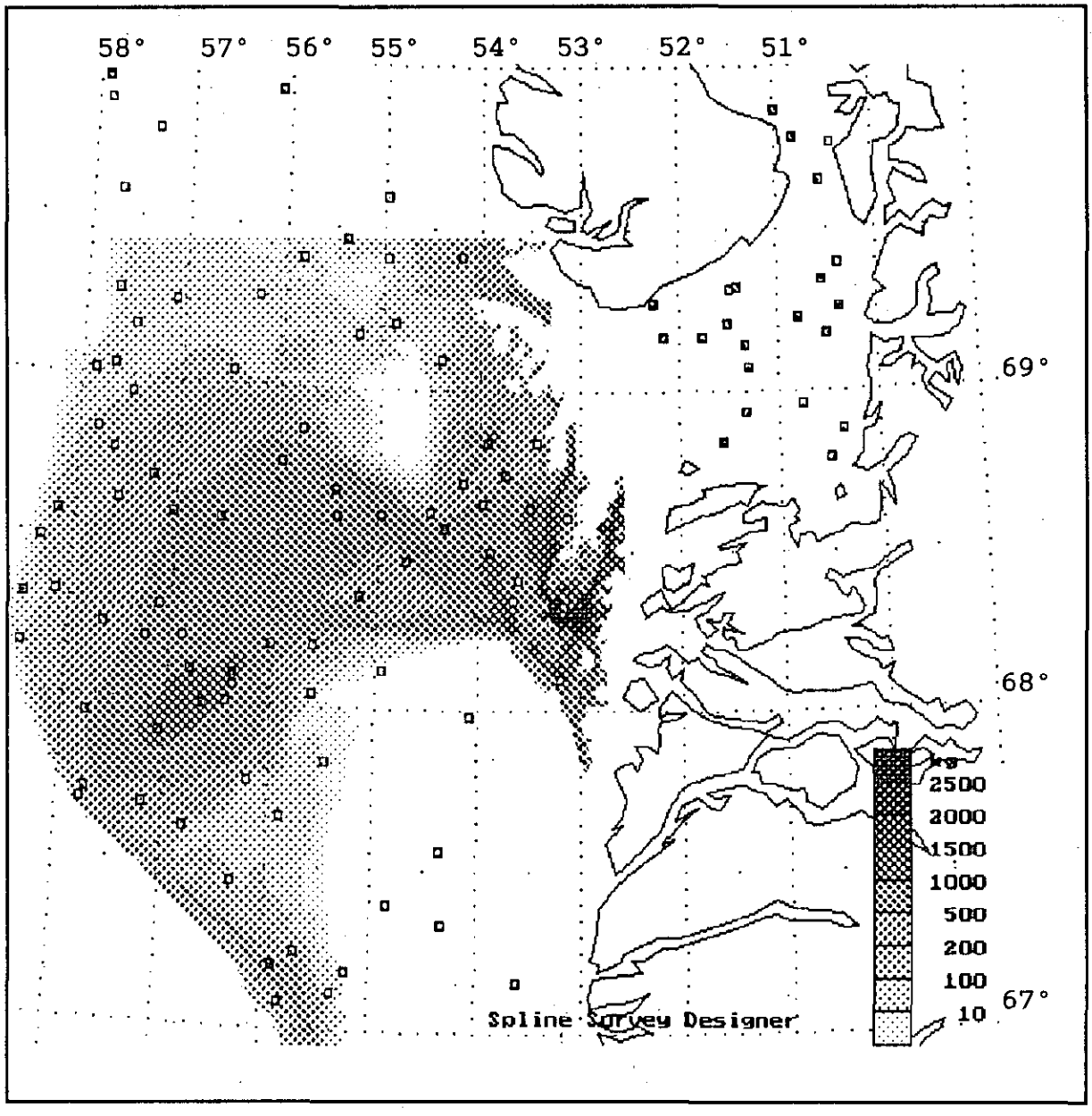

Figure 4c. Contour map with estimated shrimp densities 1994 for the area 67°N-69°30'N as calculated with the 'spline' method, based on survey data. Sampling sites are also given.

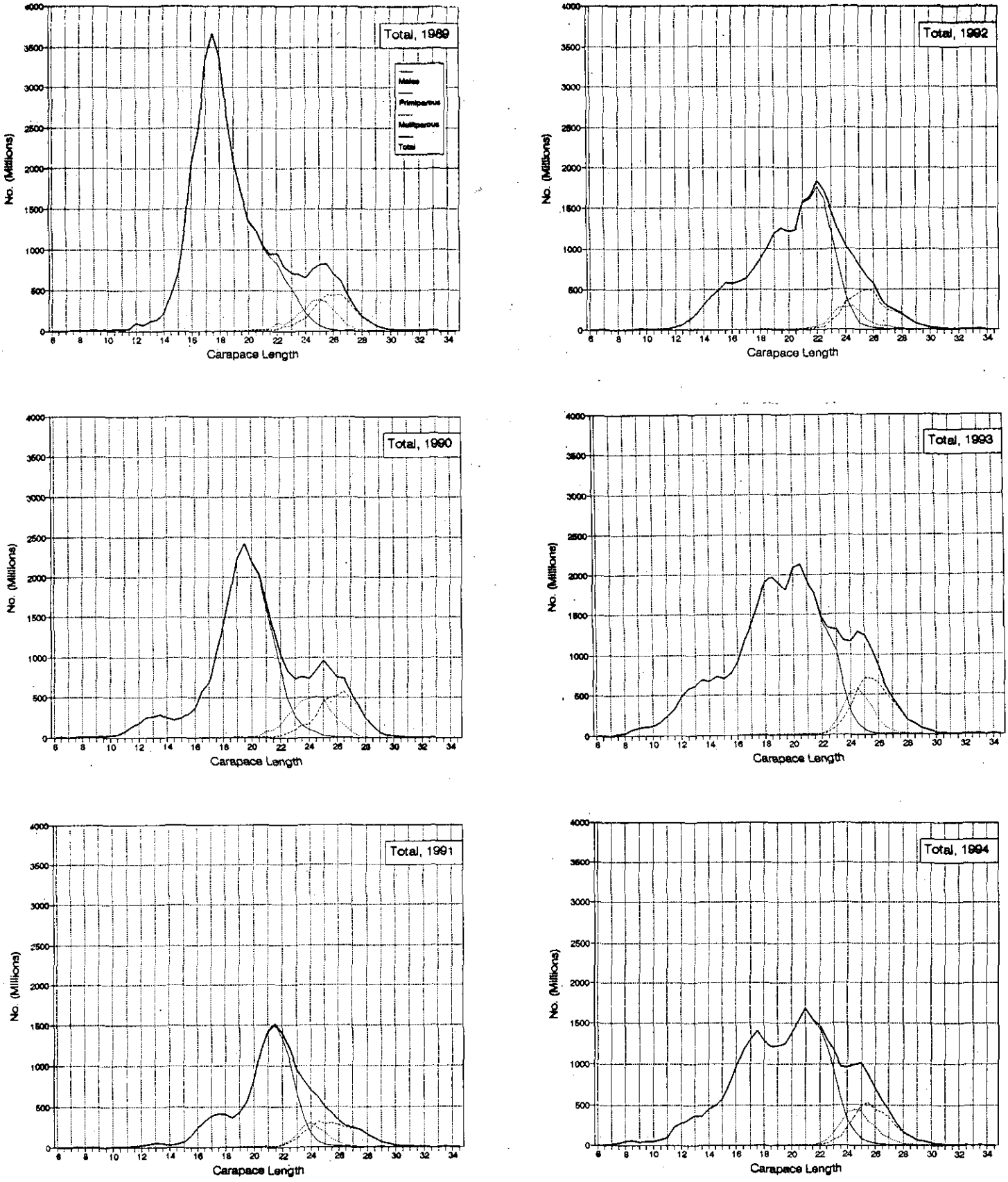

Figure 5. Numbers of shrimp by length group (CL) in the total survey area in 1989-94, based on pooling of samples weighted by catch and stratum area.

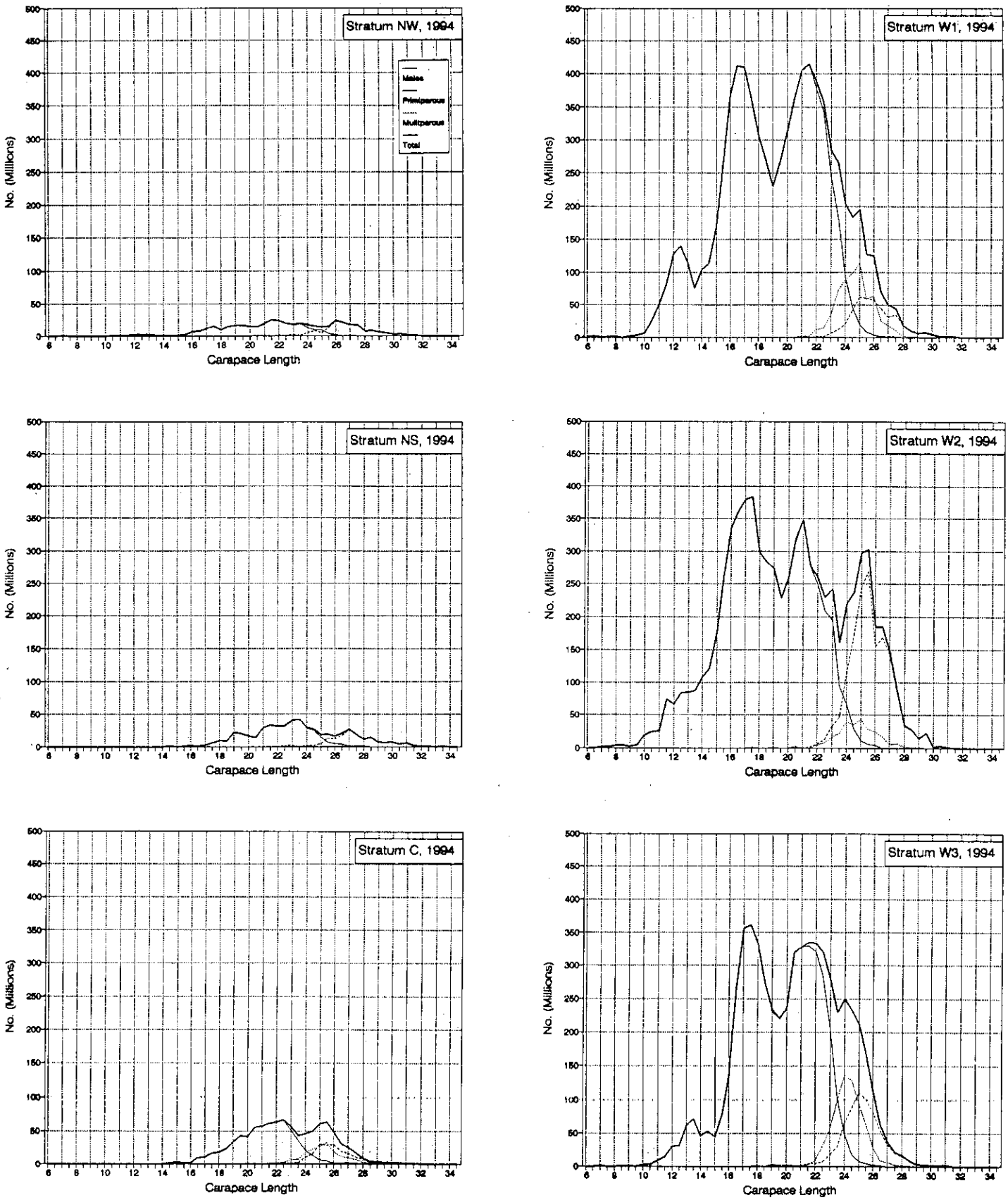

Figure 6a. Numbers of shrimp by length group (CL) in strata NW, NS, C and W1-W3 in 1994, based on pooling of samples weighted by catch and stratum area.

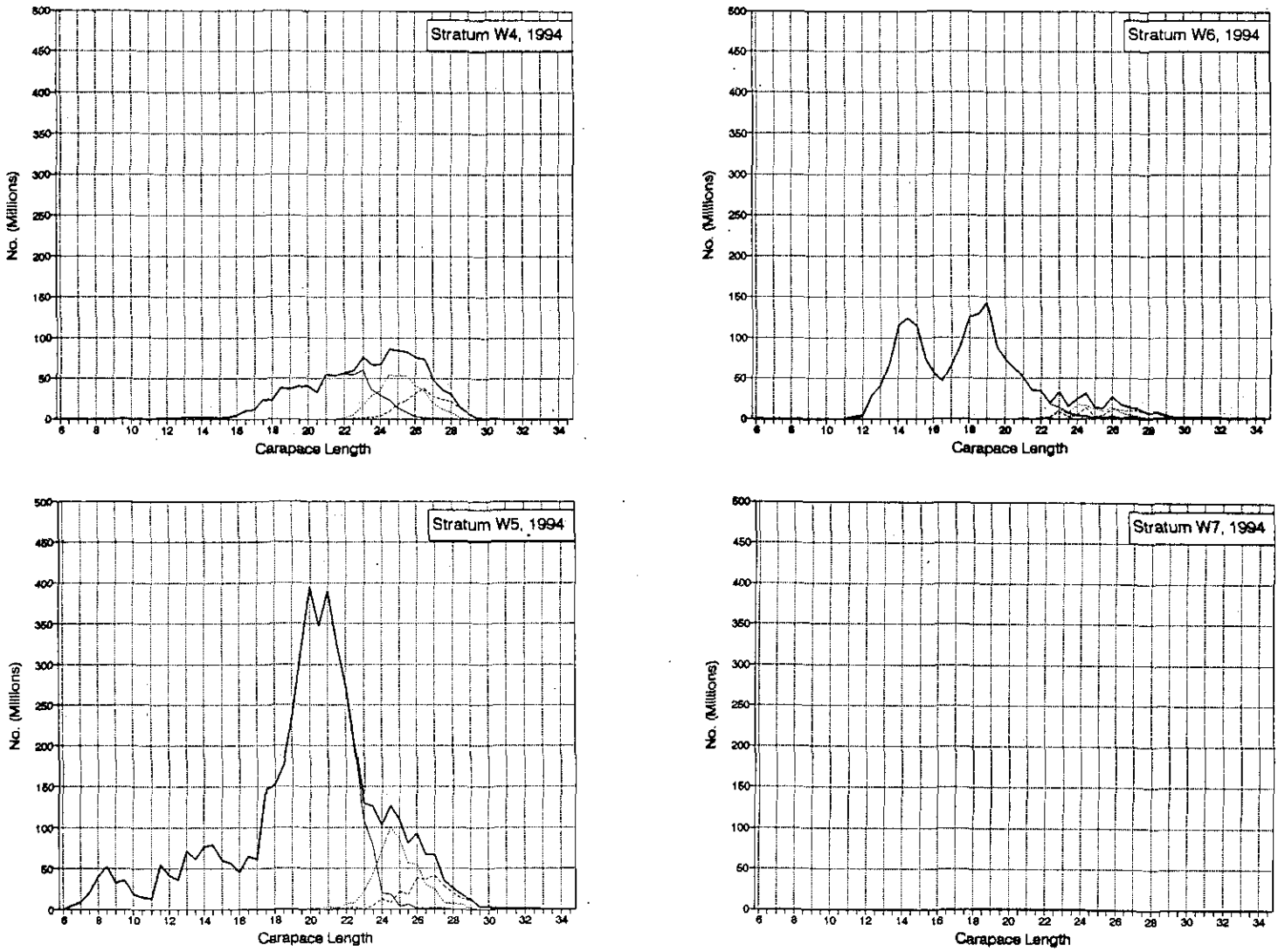

Figure 6b. Numbers of shrimp by length group (CL) in strata W4-W7 in 1994, based on pooling of samples weighted by catch and stratum area.