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Trawl survey for shrimp (*Pandalus borealis*)
in Denmark Strait, 1996

by

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INTRODUCTION

Annual trawl surveys for estimating the shrimp stock biomass in
Denmark Strait have been carried out since 1989 (except for 1991
and 1993). While the survey in 1989 covered the commercial
fishery area only, later surveys were aimed to cover the total
stock distribution area (Kanneworff & Lehmann, 1991).

All surveys were carried out in the September-October period
because this period normally is the best to avoid severe problems
with bad weather and ice cover. Although it is known that shrimp
densities are lower at this time of the year - compared to the
December-May period, where most of the commercial catches are
taken - it is hoped that a time series of survey results will
show that biomass estimates may be useful as indices of the
status of the stock.

In 1989, 1990, and 1992 the surveys were based on the stratified-
random technique. From 1994 a new sampling technique based on the
Spline Survey Designer Software System (Stolyarenko, 1987; 1993)
was introduced (Andersen et al., 1994).

The Icelandic authorities kindly granted permission to carry out
research in the Icelandic economic zone.

MATERIAL AND METHODS

The survey was performed with the 722 GRT trawler *Paamiut*, using
a 3000/20 meshes *Skjervøy* shrimp trawl with bobbins gear and a 20
mm double-bag in the codend. Trawl doors were *Greenland Perfect*,
size 370*270 cm. Trawl performance was observed with a *Furuno*
trawleye on the headrope.

Standard towing time was 60 minutes. Trawling was carried out in
day-time (0800-1800 UTC) only, to minimize the influence of
vertical migrations. Trawling distance (calculated from GPS
positions at beginning and end of the haul) and mean wing spread
(calculated during the surveys at West Greenland this year from
SCANMAR measurements of distance between doors) were used to
estimate a swept area for each haul.

The survey area (Fig. 1) covered the supposed main distribution
area of the shrimp stock, i.e. the offshore area between 65°N and
68°N, bordered to the east by the 600 m depth contour.

Based on information from the earlier surveys a sampling scheme
for the primary phase of the survey was constructed by means of
the Spline Survey Designer Software System (Stolyarenko, loc.
cit.). The number of planned first phase sampling sites (50) was
chosen as about 2/3 of the expected total number of stations that
could be visited during the allocated survey period. In some
cases when shrimp concentrations were found, second phase trawl
stations were taken immediately to reduce steaming time.
Positions of second phase stations were selected by the use of
density maps from the Spline program based on results from
already taken stations.

The total catch from each haul was sorted and weighed by species.
A sample of shrimp was taken from the cod-end or - when catches
were small - from the pounder. Shrimps were sorted by sexual
characteristics, and oblique carapace length was measured to the
nearest 0.1 mm.

The shrimp catch per standard trawling area (0.11 km², roughly
corresponding to a haul duration of 60 minutes) was calculated as
input value for the Spline computer programme.

RESULTS AND DISCUSSION

Due to very bad weather conditions during an extensive part of
the survey period a total of only 40 stations were fished (Table
1). Of these 34 belonged to the primary sampling scheme and six
were second phase stations (Fig. 1).

Biomass

The bad coverage of the area made it meaningless to estimate a
total biomass index by the SPLINE method, since a few stations
with relatively high catches drive shrimp density up in some
areas, and only few second phase stations were taken to
delimitate these concentrations.

Stock composition

Overall length frequency distributions for the surveys prior to
1994 were constructed by pooling of samples after weighting with
catch and stratum area (Carlsson and Kanneworff, 1993). Although
the spline method was used since 1994, overall length frequency
distributions were constructed for 1994 and 1995, based on the
stratum areas used in the earlier surveys, and the total number
of shrimp estimated over the years in the traditional survey area
was calculated (strata used in earlier surveys are shown in Fig.
6):

	males	females	total
1989	231.0	135.4	366.3
1990	142.6	85.7	228.3
1992	163.6	45.3	209.0
1994	264.4	90.4	354.8
1995	315.7	109.9	425.6

For 1996 an overall length frequency distribution was constructed
for the sampled strata (Fig. 1) by the same method (Table 2 and
Fig. 2). The calculated numbers of shrimp are:

1996	527.3	124.0	651.3

The 1996 sampling scheme was far from being completed, but only
four stations from the primary sampling scheme in the sampled

strata were not taken (one in stratum 7 and 14, two in stratum 30). Further six second phase station were taken in these strata (one in stratum 7, three in stratum 27, and two in stratum 29). It is therefore assumed that some information on the shrimp stock in 1996 may be deduced from the results:

1. Shrimp abundance was generally higher in 1996 as indicated by the total numbers of shrimp. Many stations in areas with zero or near-zero catches in 1995 yielded somewhat higher catches in 1996.

2. In the sampled strata shrimp abundance was highest in the same strata as in previous year (strata 14, 15, and 16), but shrimp concentrations were found also in the northwestern strata (1 and 7) and in the southwestern area (strata 27 and 28) (Fig. 3).

3. The overall length frequency distribution for the sampled strata (Fig. 2) is very similar to the distribution found in 1995 for the total area. Males are dominated by a peak at 24 mm CL, with indications of other peaks at 17, 19 and 21 mm CL. Females are peaking at 29 and 27.5 mm CL, with indications of a number of smaller groups.

REFERENCES

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Table 1. List of stations in the shrimp survey north of 65°N in Denmark Strait, 1996. Catches are given in kg.

STATION-IDENTIFICATION	AREA-CODE	DEPTH	TR-TIME	SHR	COD	GHL	RED	MIX	TOTAL
STRATUM Q1									
96PA0050035 645	KN111	348.5	59	30	0	1	8	6	45
96PA0050037 648	KP112	306.5	60	30	0	2	1	22	55
96PA0050036 650	KR110	299.0	60	0	0	0	0	10	10
STRATUM Q3									
96PA0050039 646	KN118	303.5	60	4	0	0	0	12	16
STRATUM Q7									
96PA0050030 638	KK110	436.5	61	38	0	12	0	15	65
96PA0050032 639	KK111	210.5	60	0	0	0	0	665	665
96PA0050033 658	KM109	561.5	54	10	0	7	0	360	377
96PA0050034 643	KM111	280.5	50	23	0	1	1	6	31
STRATUM Q8									
96PA0050038 642	KM115	205.5	60	0	0	0	0	17	17
STRATUM Q9									
96PA0050019 637	KJ120	351.5	60	8	0	1	0	54	63
96PA0050040 641	KM120	291.5	45	0	0	0	0	265	265
STRATUM Q13									
96PA0050026 623	KF108	467.5	60	1	0	1	1	5	8
96PA0050027 628	KG105	332.0	60	7	0	0	0	9	16
96PA0050028 631	KH106	252.5	54	0	0	0	0	7	7
96PA0050029 630	KH108	474.0	61	1	0	2	1	12	17
STRATUM Q14									
96PA0050025 624	KF111	394.5	60	13	0	7	0	10	30
STRATUM Q15									
96PA0050022 626	KF114	313.0	60	26	0	9	0	48	82
STRATUM Q16									
96PA0050021 625	KF117	335.0	60	76	0	7	0	68	152
96PA0050020 629	KH119	333.5	60	5	0	0	0	65	71
STRATUM Q19									
96PA0050007 613	KA097	360.5	55	0	0	0	0	4	4
STRATUM Q20									
96PA0050009 614	KB101	338.0	60	0	0	0	0	1	1
96PA0050010 617	KB104	319.0	60	3	0	2	0	7	13
96PA0050008 620	KD101	311.5	43	0	0	0	0	40	41
STRATUM Q21									
96PA0050011 615	KB108	418.0	61	0	0	1	1	2	4
STRATUM Q22									
96PA0050024 618	KD110	465.5	60	18	0	7	0	34	59
96PA0050023 619	KD112	326.5	60	16	0	6	0	10	32
STRATUM Q27									
96PA0050018 656	JS093	361.5	59	20	0	1	4	0	25
96PA0050017 655	JS094	319.0	60	14	0	4	2	7	27
96PA0050016 654	JS095	269.0	60	13	0	1	0	32	45
96PA0050005 603	JT094	301.5	60	112	0	6	1	7	125
STRATUM Q28									
96PA0050003 605	JT100	298.5	60	0	0	6	1	4	11
96PA0050004 606	JV097	314.5	60	12	0	1	1	4	18
STRATUM Q29									
96PA0050015 652	JS104	446.5	60	0	0	31	0	93	124
96PA0050014 651	JV103	235.5	60	0	0	0	1	19	20
96PA0050013 607	JX102	255.0	60	0	0	0	0	32	33
STRATUM Q30									
96PA0050001 604	JS106	307.5	61	0	0	9	0	3621	3630
96PA0050012 608	JV105	293.5	60	14	0	2	2	37	55
STRATUM Q36									
96PA0050002 601	JR100	294.0	59	0	3	0	0	10	13

Table 2. Number of shrimp (millions) per length group (CL) in total biomass estimate north of 65°N.

| 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	0.0	0.0	0.0	0.0
6.5	0.0	0.0	0.0	0.0
7.0	0.0	0.0	0.0	0.0
7.5	0.0	0.0	0.0	0.0
8.0	0.0	0.0	0.0	0.0
8.5	0.0	0.0	0.0	0.0
9.0	0.0	0.0	0.0	0.0
9.5	0.0	0.0	0.0	0.0
10.0	0.0	0.0	0.0	0.0
10.5	0.0	0.0	0.0	0.0
11.0	0.0	0.0	0.0	0.0
11.5	0.0	0.0	0.0	0.0
12.0	0.0	0.0	0.0	0.0
12.5	0.1	0.0	0.0	0.1
13.0	0.0	0.0	0.0	0.0
13.5	0.1	0.0	0.0	0.1
14.0	0.0	0.0	0.0	0.0
14.5	0.9	0.0	0.0	0.9
15.0	0.2	0.0	0.0	0.2
15.5	1.1	0.0	0.0	1.1
16.0	1.3	0.0	0.0	1.3
16.5	1.9	0.0	0.0	1.9
17.0	4.0	0.0	0.0	4.0
17.5	4.1	0.0	0.0	4.1
18.0	5.2	0.0	0.0	5.2
18.5	6.3	0.0	0.0	6.3
19.0	14.4	0.0	0.0	14.4
19.5	14.7	0.0	0.1	14.8
20.0	16.1	0.0	0.1	16.2
20.5	20.8	0.1	0.1	21.0
21.0	25.0	0.0	0.3	25.3
21.5	27.0	0.0	0.3	27.4
22.0	34.2	0.0	0.2	34.4
22.5	38.6	0.0	0.1	38.8
23.0	38.9	0.0	1.1	40.0
23.5	38.6	0.0	1.1	39.7
24.0	43.5	0.1	0.9	44.4
24.5	38.8	0.0	1.0	39.8
25.0	35.7	0.0	2.2	37.9
25.5	34.8	0.0	2.0	36.8
26.0	29.8	0.1	3.0	32.8
26.5	22.0	0.0	4.4	26.3
27.0	13.8	0.0	6.0	19.8
27.5	8.5	0.0	10.4	19.0
28.0	4.9	0.0	9.6	14.5
28.5	1.6	0.0	12.2	13.8
29.0	0.3	0.0	16.1	16.4
29.5	0.2	0.2	12.9	13.3
30.0	0.1	0.0	11.2	11.3
30.5	0.0	0.0	9.7	9.7
31.0	0.0	0.0	7.8	7.8
31.5	0.0	0.0	3.8	3.8
32.0	0.0	0.0	3.0	3.0
32.5	0.0	0.0	2.2	2.2
33.0	0.0	0.0	1.1	1.1
33.5	0.0	0.0	0.2	0.2
34.0	0.0	0.0	0.2	0.2
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	0.1	0.1
36.0	0.0	0.0	0.0	0.0
36.5	0.0	0.0	0.0	0.0
Total	527.3	0.5	123.4	651.3
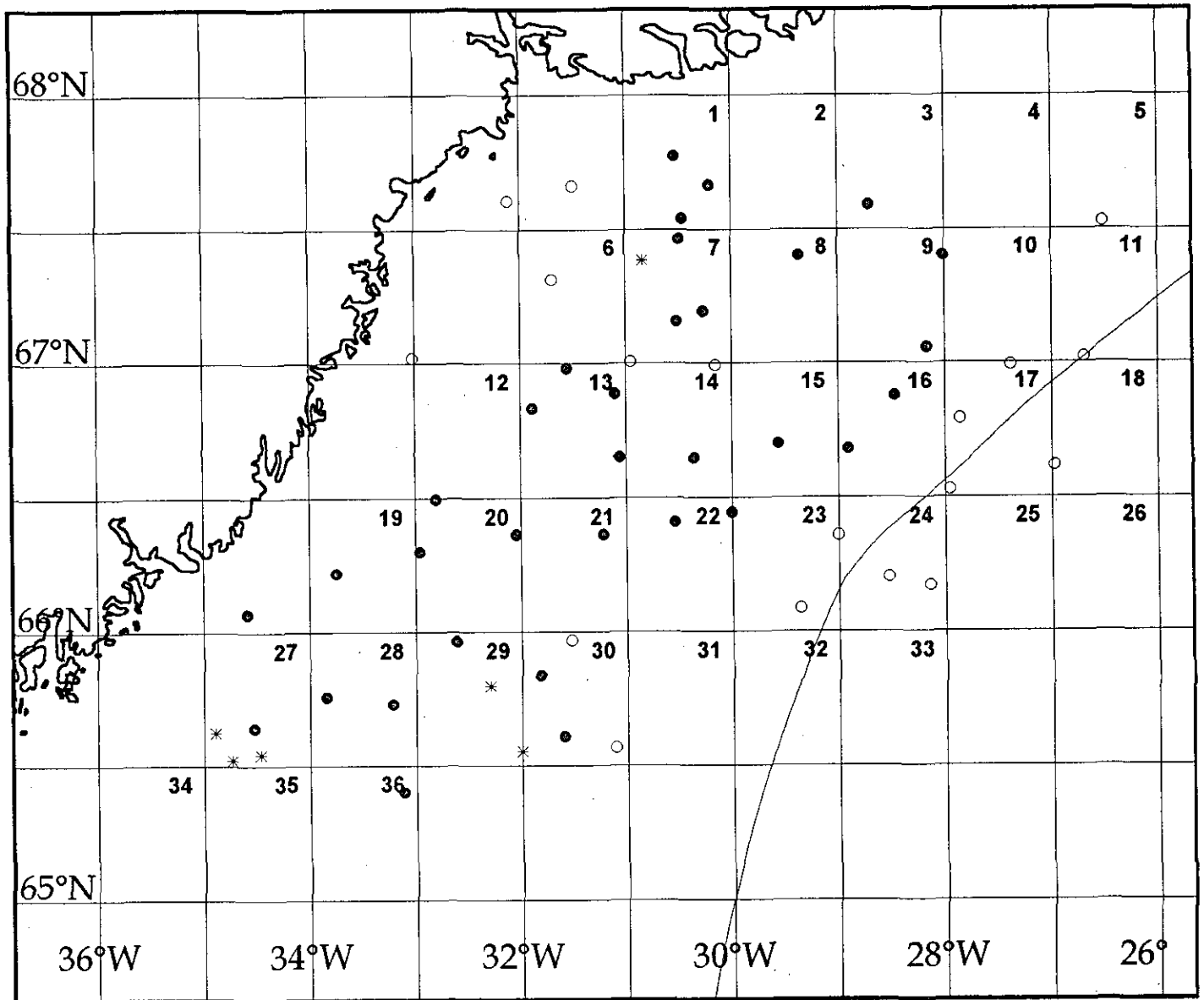
Figure 1. Map of survey area (N of 65°N) showing the location of planned and taken
stations. Circles show planned trawling positions in the first phase of the
survey (of which the filled circles denote stations taken). Phase two stations
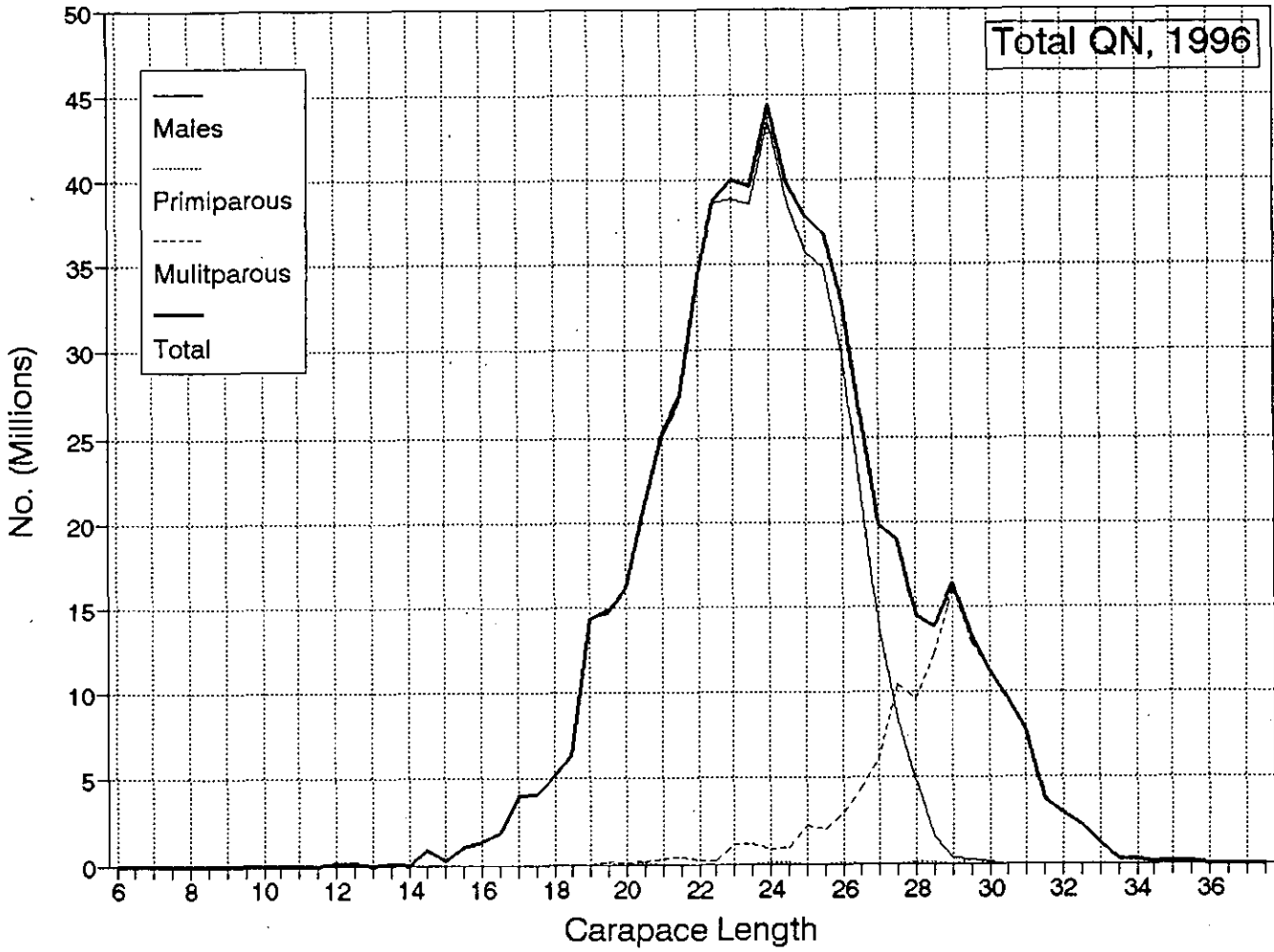are indicated by stars.

Figure 2. Numbers of shrimp (millions) by length group (CL) in the area north of 65°N.

	1	2	3	4	5
	46.4		15.2		
	16.7		1.9		
	63.1		17.1		

6	7	8	9	10	11
	37.0	0.8	4.5		
	18.0	0.1	5.7		
	55.0	0.9	10.1		

12	13	14	15	16	17	18
	6.2	36.8	77.6	134.3		
	1.8	3.5	11.4	14.3		
	8.0	40.2	89.1	148.6		

19	20	21	22	23	24	25	26
0.1	1.4	0.1	42.6				
0.1	0.5	0.1	11.5				
0.1	1.9	0.2	54.1				

27	28	29	30	31	32	33
97.4	20.7	0.1	6.2			
23.8	2.1	0.0	12.4			
121.2	22.8	0.1	18.6			

34	35	36
		0.1
		0.0
		0.2

68°N 67°N 66°N 65°N

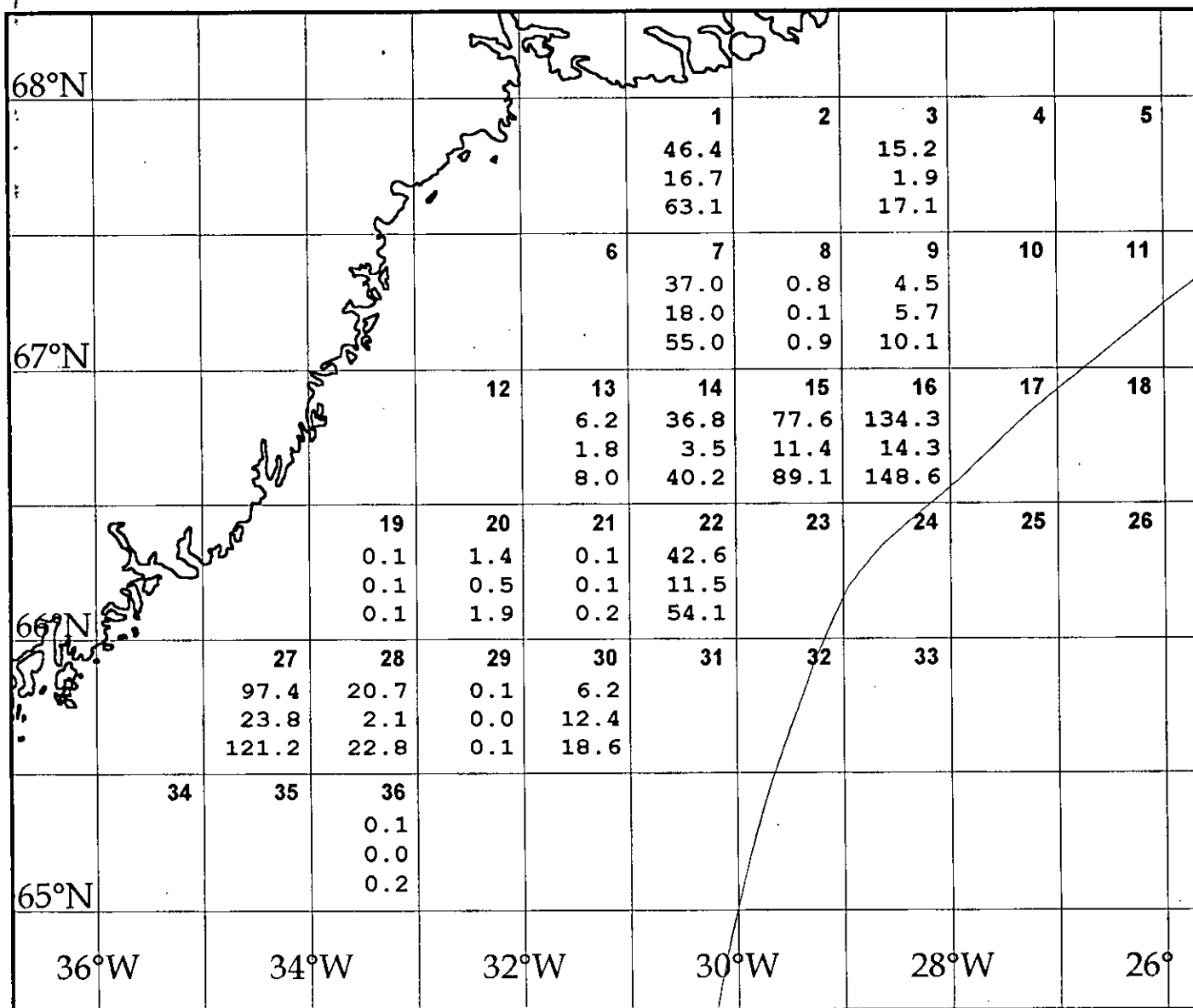36°W   34°W   32°W   30°W   28°W   26°

Figure 3. Calculated numbers of shrimp (males, females and total, in millions) per stratum north of 65°N in 1996.