

Northwest Atlantic



Fisheries Organization

Serial No. N6224

NAFO SCR Doc. 13/062

**NAFO/ICES PANDALUS ASSESSMENT GROUP MEETING – OCTOBER 2013**

**Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*)  
Off East Greenland (ICES Subarea XIV b), 2008-2013**

by

Helle Siegstad.

Greenland Institute of Natural Resources  
Box 570, 3900 Nuuk, Greenland

**Abstract**

Since 2008 the Greenland Institute of Natural Resources has carried out annual stratified-random trawl surveys in East Greenland area in August and September to assess the *Pandalus borealis* stock biomass and obtain information on the size and sex composition of the stock as well as on the environmental conditions. A total number of 52, 97, 82, 85, 98 and 92 valid hauls were made from 2008 - 2013. The surveys conducted since 2008 shows that the shrimp stock is concentrated in the area north of 64°N and in depth between 200 and 600 meter.

The biomass estimates (in tons) for the entire survey area are low compared to West Greenland. The survey biomass estimate is probably not a reflection of the status of the stock biomass. Absence of the smaller male and juvenile shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown.

**Introduction**

Since 2008 stratified-random trawl surveys has been conducted to assess the stock status of northern shrimp in East Greenland. The main objectives were to obtain indices for stock biomass, abundance, recruitment and demographic composition. The area was also surveyed in 1985-1988 (Norwegian survey) and in 1989-1996 (Greenlandic survey). The historic survey is not directly comparable with the recent survey due to different area coverage, survey technique and trawling gear. However, both showed similar levels of biomass and abundance and the presence of large shrimps. Absence of the smaller male and juvenile shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown. This document presents results on biomass, abundance and sex-composition from 2008 - 2013 surveys, and attempt to compare these results with survey conducted in 1989-1996.

**Material and Methods**

The survey is carried out with the same gear and survey protocols as used in West Greenland (Kingsley *et al.*, 2012). Stratification was based on the “Q-areas” used for the East Greenland survey for Greenland halibut (Fig. 1.) The areas are further depth stratified into 0-200 m, 200-400m and 400-600 m zones (area sizes are given in table 1). Total survey area has been estimated to 118.107 km<sup>2</sup>. Standard tow duration was set to 15 minutes at all stations. Towing speed have been about 2.5 knots in all cases.

Stations were randomly selected from historical known trawlable sites, however, a number of the selected positions were not deemed trawl able. A total number of 52, 97, 82, 85, 98 and 97 valid hauls were made from 2008 to

2013(table 1). Trawling has been carried out days and nights (24 hours). The influence of light induced nocturnal vertical migrations of shrimp has not been taking into account in the estimation of biomass.

#### *Biomass estimation*

For each tow, the catch was divided by the estimated swept area calculated from wingspread and track length to estimate haul by haul biomass density. Mean stratum densities were multiplied by the stratum area to compute stratum biomass, and corresponding coefficients of variation (CV, in %) for each stratum were calculated from the swept area estimate of the biomass (B) and the standard deviation of the density times the stratum area (STD) – see Kingsley et al, 2012 for details.

#### *Demography*

From each catch a sample of about 0.5 to 3 kg of shrimp was taken and sorted to species. All specimens of Northern Shrimp were grouped into males, primiparous and multiparous females based on their sexual characteristics according to Allen (1959) and McCrary (1971). The oblique carapace length (CL) of each shrimp in the sub sample was furthermore measured to the nearest 0.1 mm using callipers.

The West Greenland length-weight relationship ( $0.000578537 * \text{ShrimpLength}^{**2.9941} / 1000$ ) was used on the East Greenland shrimp sample to estimate the female and males' abundance and proportion of females.

### **Results and Discussion**

#### *Biomass and Stock composition*

For all strata biomass estimates have been calculated (Tab.2 and Tab.3) on the basis of the nominal swept area (Kingsley *et al.*, 2012). The biomass estimates (in tons) for the entire survey area are:

YEAR	BIOMASSE	+/-	ECV (PERCENT)
2008	1953	1764	90.32
2009	8446	3852	45.61
2010	5758	3928	68.22
2011	5789	2760	47.68
2012	2200	1293	58.56
2013	2578	2082	80.76

The highest biomass in 2008-2012 was found north of 64°N in area Q1 and Q3 (Fig. 1). In 2013 98% of the biomass is located in Q1. Shrimp biomass in the remaining southerly offshore areas (Q4-Q6) showed very low densities (Tab. 2 and Fig. 3). The shrimp occurs mainly between 200 - 400 meter and 400 – 600 meter. In 2013 47% of the biomass is found in the 400-600 meter, a change compare to the 2009-2012 proportion on less than 20%.

The demographic structure in East Greenland shows large males with 20 mm CL as the smallest (Fig. 4). A calculation of the fishable biomass of individuals equal to and above 17 mm CL has therefore not been calculated. Biomass and abundance of female and males weighted up to total biomass are presented in Tab 6 and Tab 7. Female biomass is on average on 1.946tons (6 years). In 2013 female biomass was on 1.154 tons (tab. 7).

Total numbers of shrimp (males and females) in 2013 was estimated to 227 million or almost half of the average on 428 million for the six years time series. The abundance of males in 2013 is 147 million – a proportion on 65.1% or on average of the time series.

#### **Comparison with earlier surveys**

Stratified-random trawl surveys have been carried out in Denmark Strait in 1989-1992 and in 1994-1996 the surveys was conducted by a sampling technique based on the Spline Designer Software System. The surveys in the 1980ties and 1990ties were conducted in the shrimp fishing area North of 65N up to 67N. The recent surveys in 2008 to 2013 covered the shelf area from Cap Farwell to Dorhn area up to 67N. To compare the two survey time series only the

areas Q1 and Q2 in the 2008-2013 surveys are used. Table 8 list the biomass estimates, numbers of stations, area covered, cod-end mesh size and survey technique from all surveys in 1980ties and 1990ties and the recent surveys from 2008 - 2013. It is difficult to compare the different surveys due to different survey technique and trawling gear. However the low biomass estimate and the demographic structure in all surveys is very much in correspondence.

### Conclusions

The biomass of shrimp in East Greenland in 2013 is estimated to be at the same low level as in 2008 and 2012, and is estimated to be the third lowest in the series. In 2009-2011 biomass was estimated to more than double of the 2012 and 2013 value. The survey biomass estimate is probably not a reflection of the status of the stock biomass. Absence of the smaller male and juvenile shrimp in the survey area stresses that the total area of distribution and recruitment patterns of the stock are still unknown.

### References

- ANDERSEN, M., CARLSSON, D. M., and P. KANNEWORFF. 1994. Trawl survey for shrimp (*Pandalus borealis*) in Denmark Strait, 1994. *NAFO SCR Doc.*, No. 90, Serial No. N2477.
- CARLSSON, D. M. 1996. Trawl survey for shrimp (*Pandalus borealis*) in Denmark Strait, 1996. *NAFO SCR Doc.*, No. 116, Serial No. N2813.
- CARLSSON, D. M., and P. KANNEWORFF. 1995. Trawl survey for shrimp (*Pandalus borealis*) in Denmark Strait, 1995. *NAFO SCR Doc.*, No. 109, Serial No. N2648.
- KANNEWORFF, P. and K.M. Lehmann 1993. Stratified-Random Trawl Survey for shrimp (*Pandalus borealis*) in Denmark Strait, 1990. *NAFO SCR Doc.*, No. 52, Serial No. N1935.
- BURMEISTER, A, M.C.S. KINGSLEY AND H. SIEGSTAD 2013. The West Greenland trawl survey for *Pandalus borealis*, 2013, with reference to earlier results. *NAFO SCR Doc.*, No. 13/056 Serial No. N6217.

Table 1. Vessels, trawl types and rigging parameters used in the Greenland Bottom Trawl Survey for shrimp and fish, 2008–2013.

	Vessel	Trawl	Bridle length (m)	Wing-spread (m)	
2008–2013	Paamiut	Cosmos	54.0	28.1-30	**

Table 2. Survey estimates of total biomass 2012.

Stratum	Area (km <sup>2</sup> )	Stations	Biomass density (t/km <sup>2</sup> )	Biomass (Kt)	Biomass error variance	Error coefft of variation (%)
Q1-0	0	0	0.00	0.00	0.00	0.00
Q1-2	35662	20	0.04	1.32	0.16	30.24
Q1-4	6975	5	0.17	1.21	0.92	79.29
Overall Q1	42637	25	0.06	2.53	1.08	41.12
Q2-0	93	2	0.00	0.00	0.00	0.00
Q2-2	7657	7	0.00	0.01	0.00	74.28
Q2-4	1246	3	0.00	0.00	0.00	0.00
Overall Q2	8996	12	0.00	0.01	0.00	74.28
Q3-0	3363	3	0.00	0.00	0.00	0.00
Q3-2	22547	10	0.00	0.03	0.00	72.92
Q3-4	9830	10	0.00	0.01	0.00	49.50
Overall Q3	35740	23	0.00	0.03	0.00	55.96
Q4-0	1337	2	0.00	0.00	0.00	0.00
Q4-2	7770	9	0.00	0.00	0.00	100.00
Q4-4	2054	2	0.00	0.00	0.00	0.00
Overall Q4	11161	13	0.00	0.00	0.00	100.00
Q5-0	469	0	0.00	0.00	0.00	0.00
Q5-2	2785	3	0.00	0.00	0.00	100.00
Q5-4	1819	2	0.00	0.00	0.00	100.00
Overall Q5	5073	5	0.00	0.00	0.00	82.05
Q6-0	6307	6	0.00	0.00	0.00	0.00
Q6-2	6130	7	0.00	0.00	0.00	56.37
Q6-4	2063	1	0.00	0.00	0.00	95.00
Overall Q6	14500	14	0.00	0.00	0.00	61.15
Survey totals	118107	92	0.02	2.58	1.08	40.38

Table 3. Biomass estimates (t) for survey subdivisions and standard errors for the entire survey, 2008–2013

Year	Q1	Q2	Q3	Q4	Q5	Q6	Total	SE <sup>4</sup>
2008	1,591	7	312	4	24	17	1,955	882
2009	6,945	325	1,157	1	1	17	8,446	1861
2010	3,814	55	1,882	1	3	2	5,758	1964
2011	5,413	0	367	0	0	9	5,789	1380
2012	1,855	7	335	0	3	1	2,200	646
2013	2,532	9	34	0	1	3	2,578	1041

Table 4. Error coefficients of variation (%) for the biomass estimates of five main survey regions and the entire survey area 2008–2013

Year	Q1	Q2	Q3	Q4	Q5	Q6	Total	Number of hauls
2008	54.7	69.3	45.2	100.0	62.9	30.7	45.1	52
2009	25.2	99.8	47.4	52.8	75.0	33.6	22.0	97
2010	23.8	78.3	92.6	75.0	92.5	42.4	34.1	82
2011	25.3		44.6	100.0		40.0	23.8	85
2012	31.4	100.0	83.4	100.0	93.7	93.7	29.4	98
2013	41.1	74.3	56.0	100.0	82.0	82.0	40.4	92
Mean 2008-2013							32.5	

Table 5. Estimated mean densities (kg/km<sup>2</sup>) for survey subdivisions in 2008–2013

Year	Q1	Q2	Q3	Q4	Q5	Q6	Total
2008	37.3	0.4	7.6	0.3	3.4	1.2	14.0
2009	162.9	17.0	28.2	0.1	0.2	1.2	60.6
2010	89.5	2.9	45.9	0.1	0.4	0.2	41.3
2011	127.0	0.0	8.9	0.0	0.0	0.6	41.6
2012	43.5	0.3	8.2	0.0	0.4	0.1	15.8
2013	59.4	0.5	0.8	0.0	0.1	0.2	18.5

Table 6. Survey biomass estimates (tons) by sex based on length-weight distributions 1988–2013.

Year	Males	Females	Total	Males %	Females %
2008	1025	930	1955	52.4	47.6
2009	5572	2874	8446	66.0	34.0
2010	2640	3118	5758	45.8	54.2
2011	3258	2531	5789	56.3	43.7
2012	1130	1070	2200	51.4	48.6
2013	1424	1154	2578	55.2	44.8
Average	2508	1946	4454	54.5	45.5

Table 7. Estimated numbers ('000) by sex from length analyses 2008–2013

Year	Males	Females	Total	Males %	Females %
2008	129	72	202	64.1	35.9
2009	670	222	893	75.1	24.9
2010	288	231	519	55.5	44.5
2011	348	186	534	65.2	34.8
2012	117	77	194	60.2	39.8
2013	147	79	227	65.1	34.9
Average	283	145	428	64.2	35.8

Table 8. Two Greenlandic surveys from 1989-1996 and 2008-2013 for comparison.

Q1-Q2 (North for 65)	Biomass tons	No. Station	Area	Cod-end	Surveymethode
1989	4,879	87	33,971	44	Stratified random technique
1990	1,860	99	33,971	44	Stratified random technique
1991					
1992	1,044	37	43,439	44	Stratified random technique
1993					
1994	3,800	69		20	Spline Designer Designer
1995	4,558	72		20	Spline Designer Designer
1996	No estimate	40		20	Spline Designer Designer
.....					
2008	1,598	20	51,633	20	Stratified random technique
2009	7,270	47	51,633	20	Stratified random technique
2010	3,869	45	51,633	20	Stratified random technique
2011	5,413	31	51,633	20	Stratified random technique
2012	1,861	35	51,633	20	Stratified random technique
2013	2,541	37	51,633	20	Stratified random technique

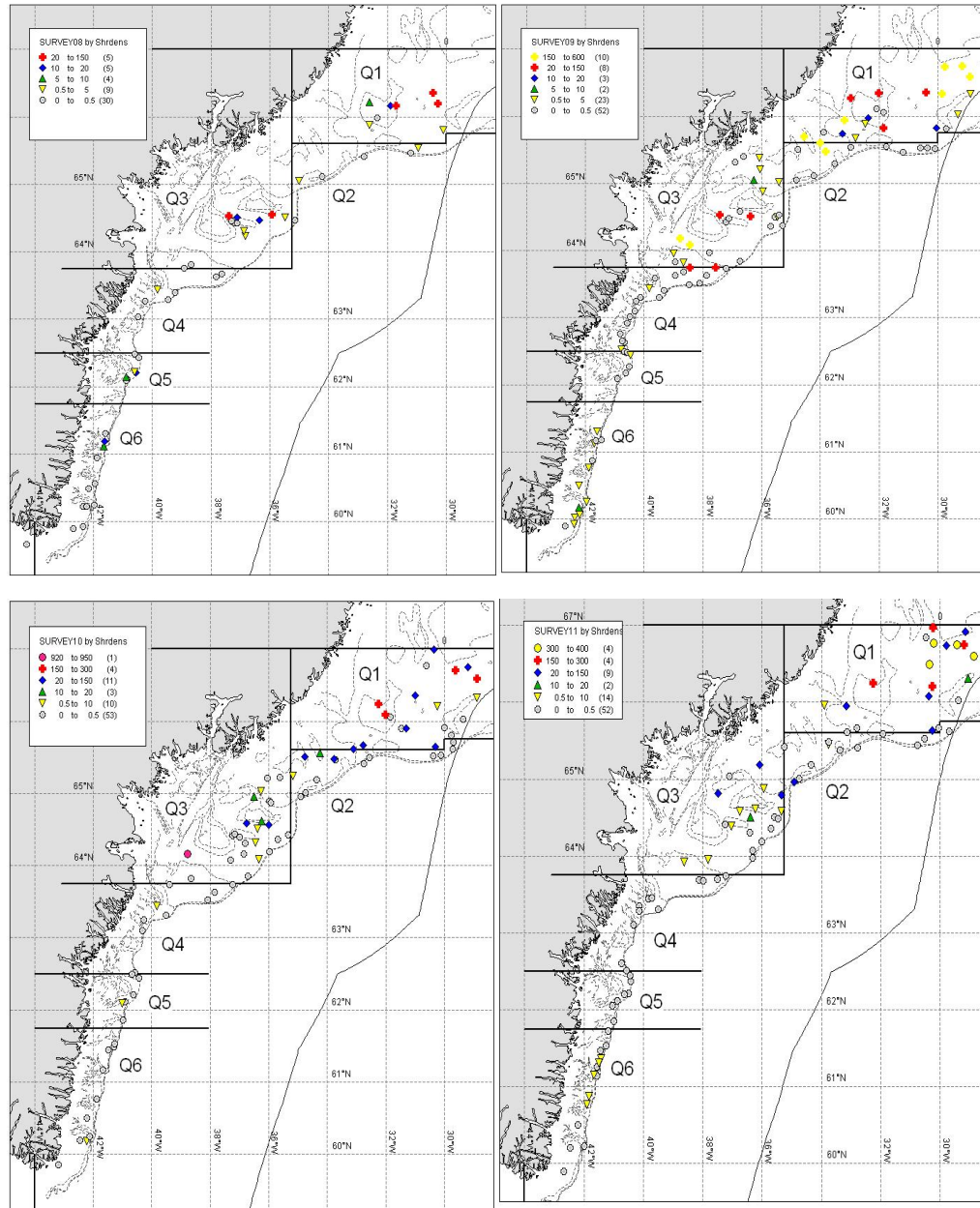


Fig.1a. Shrimp densitet in surveyarea in 2008-2011

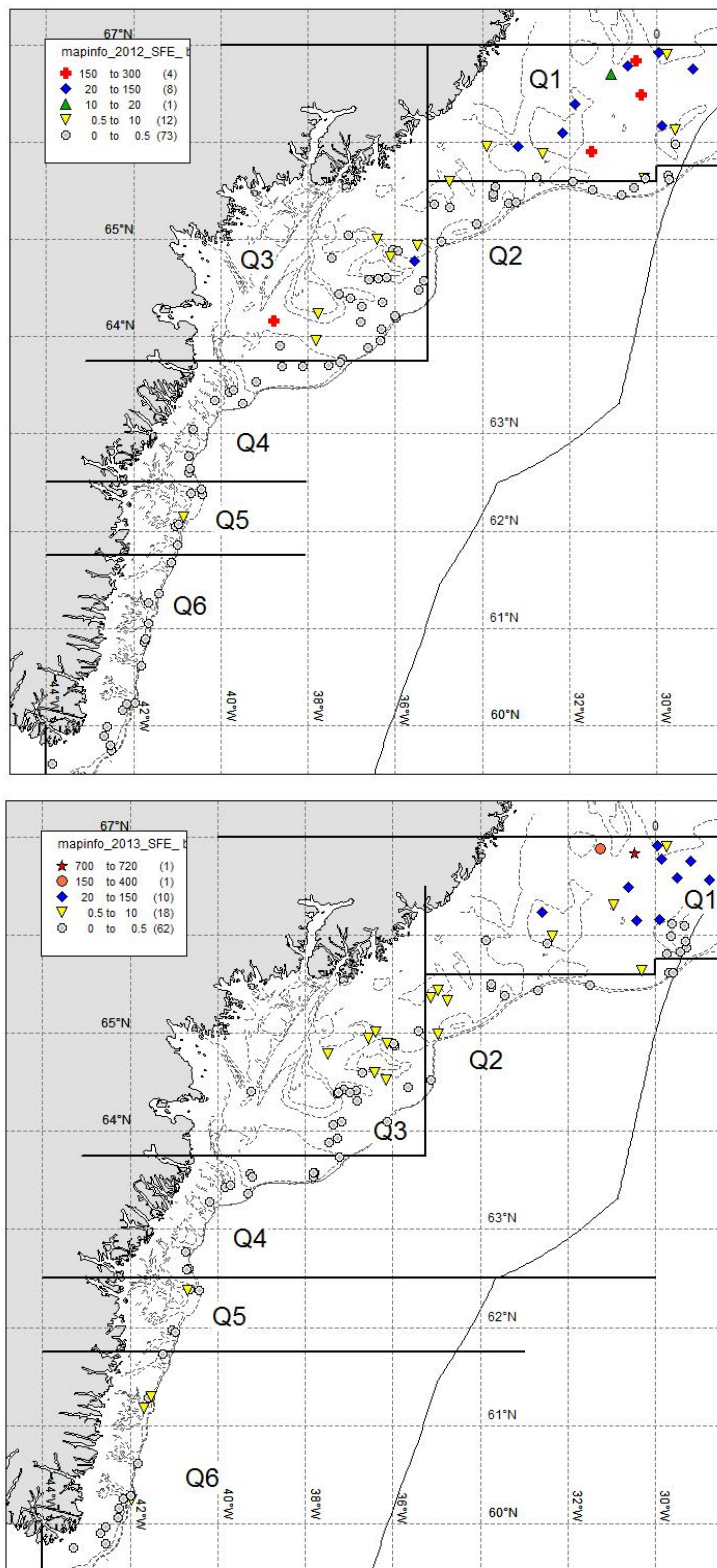


Fig.1b. Shrimp densitet in surveyarea in 2012 og 2013



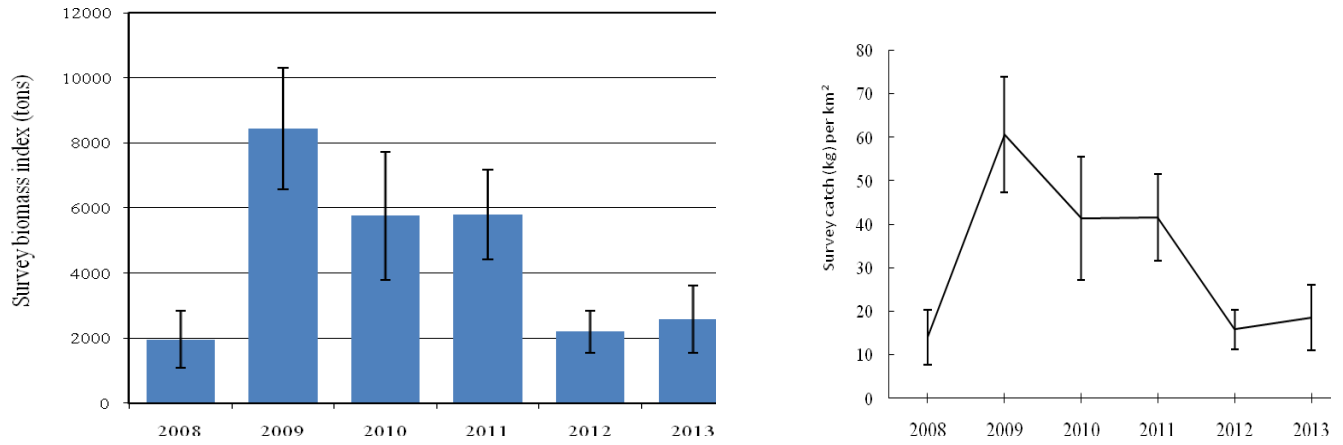


Fig. 2. Estimated total survey biomass (t) and average survey biomass density (kg/km) of Northern shrimp with standard errors 2008-2013.

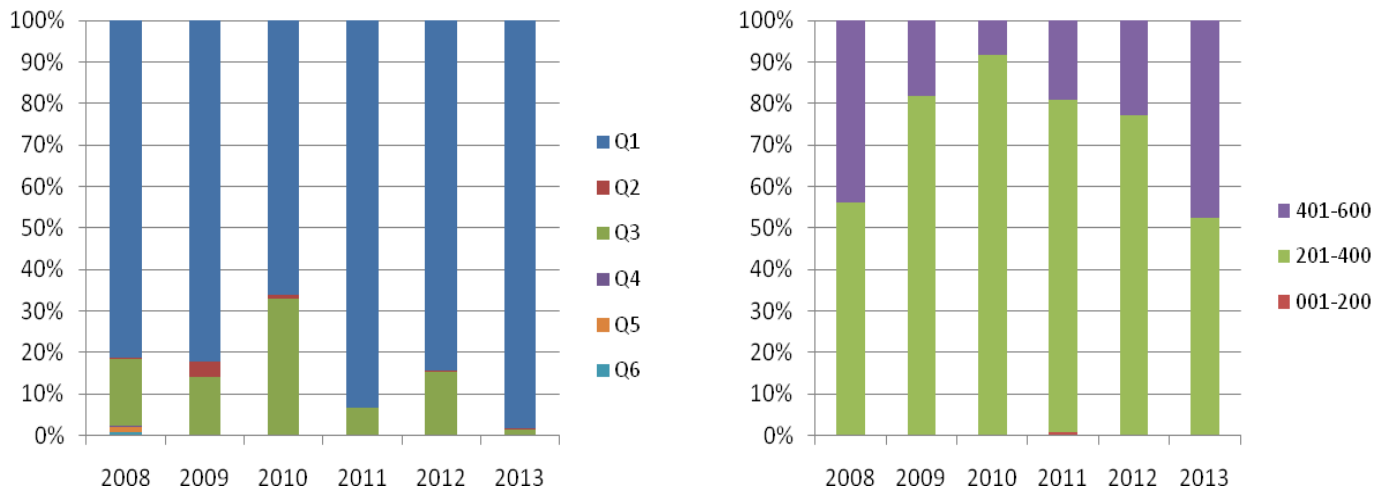


Fig. 3. Survey biomass in percent in different areas and depths 2008-2013.

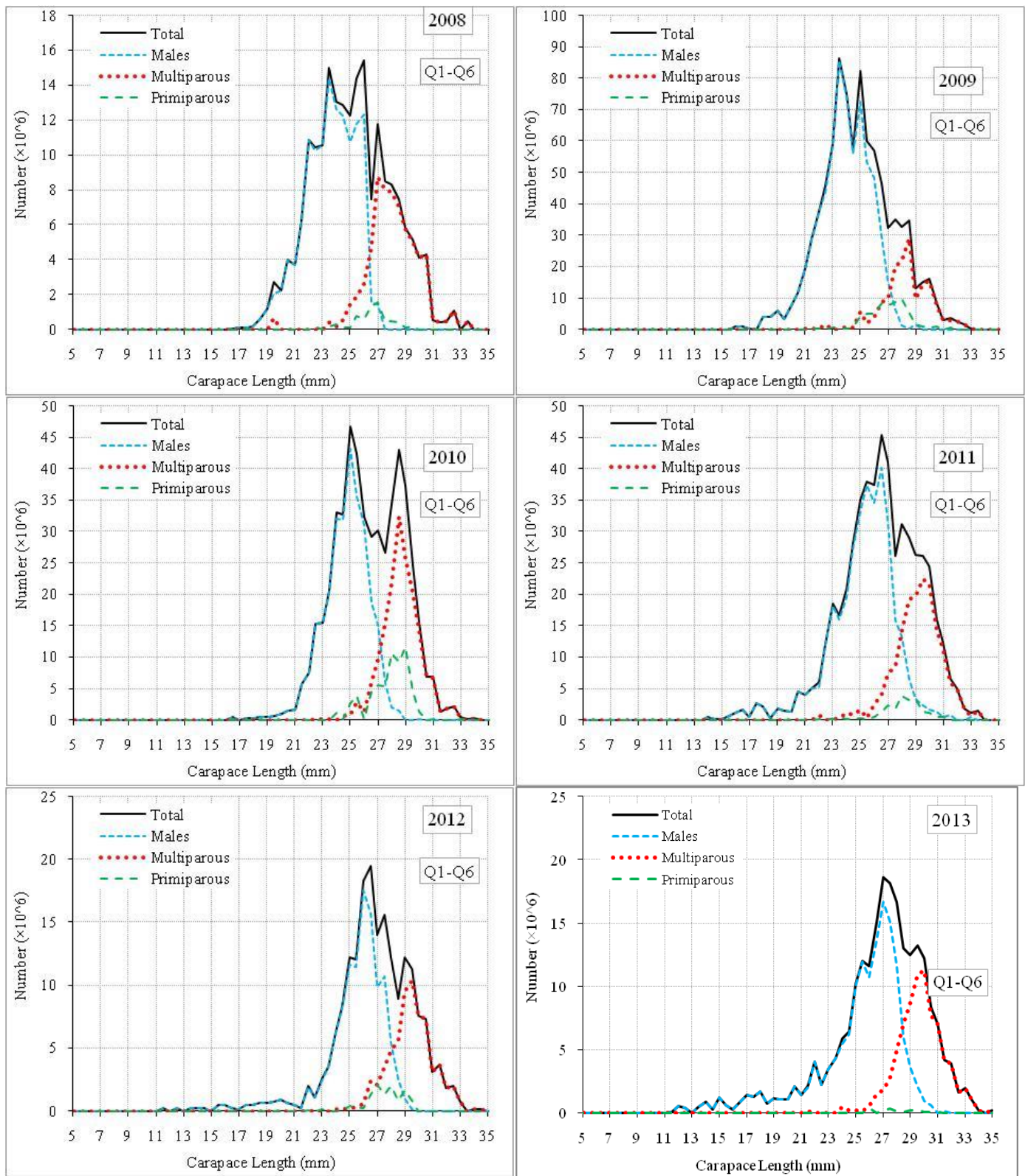


Fig.4. Numbers of shrimp by length group (CL) in the total survey area in 2008-2013, based on pooling of samples weighted by catch and stratum area.

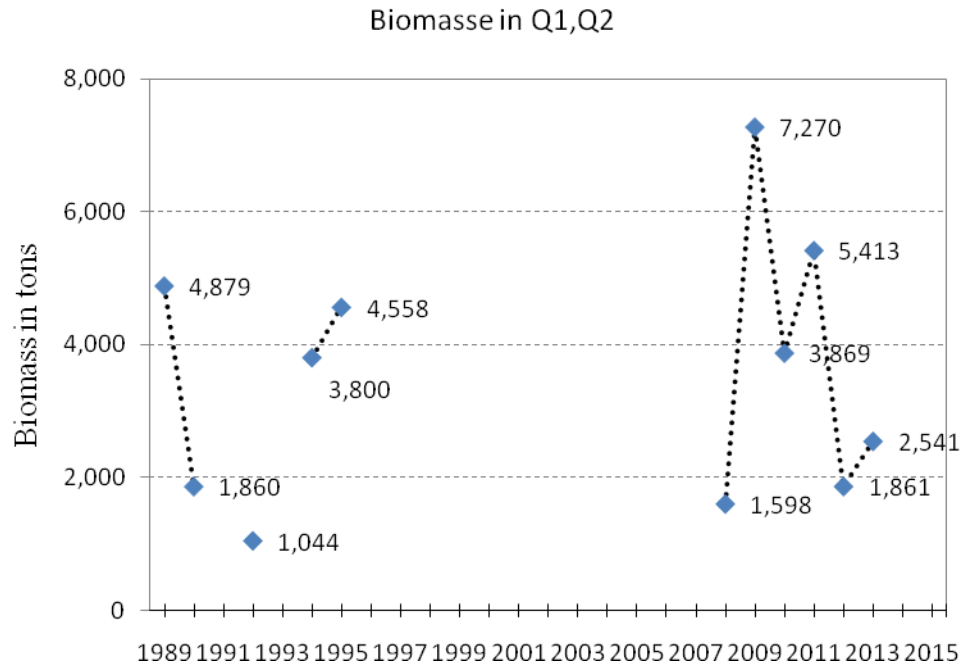


Fig.5. Biomass from two different surveys series from 1989-1995 and 2008-2013 for the areas North of 65°N and stratumarea Q1 and Q2 for comparison.

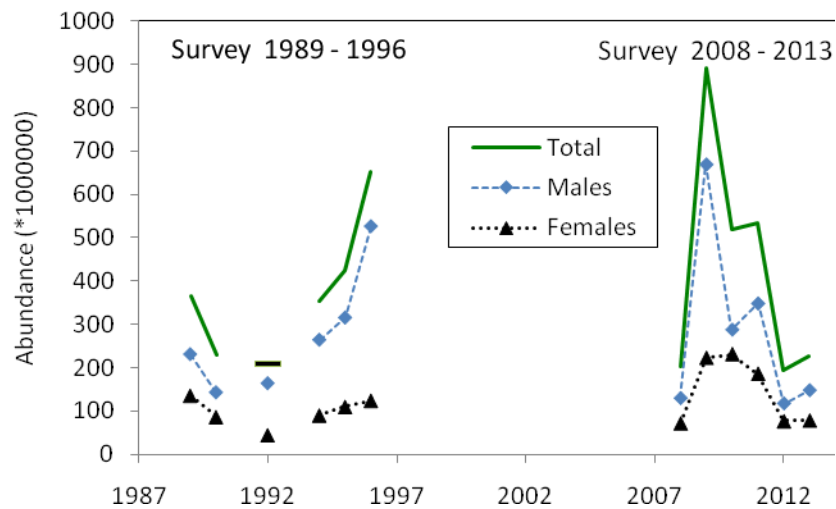


Fig. 6. Abundance of males and females in two different surveys series from 1989-1995 and 2008-2013 for the areas North of 65°N.