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Results of the Greenland Bottom Trawl Survey for Northern shrimp (*Pandalus borealis*) Off East Greenland (ICES Subarea XIV b), 2008-2011

by

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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 53, 97, 81, 85 valid hauls were made in 2008, 2009, 2010 and 2011. The highest offshore densities in 2008-2011 were found in the Northern region Q1, Q2 and Q3. Shrimp densities in the remaining southerly offshore areas (Q4-Q6) showed very low densities in all three years.

The surveys conducted since 2008 shows that the shrimp stock is concentrated in the area north of 65°N. The biomass estimates (in tons) for the entire survey area in 2008, 2009, 2010 and 2011 are: 1953, 8446, 5758 and 5789 tons.

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 comparably 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 of 2008, 2009, 2010 and 2011 surveys, and attempt to compare these results with survey conducted in 1989-1996.

Materiel and Methods

The survey is carried out with the same gear and survey protocols as used in West Greenland (Kingsley *et al.*, 2011). 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 km². 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 53, 97, 81 and 85 valid hauls were made in 2008, 2009, 2010 and 2011 (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 Siegstad et al., 2011 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*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) on the basis of the nominal swept area. The biomass estimates (in tons) for the entire survey area in 2008, 2009 and 2011 are:

YEAR	BIOMASSE	+/-	PROCENT
2008	1953	1764	90.32
2009	8446	3852	45.61
2010	5758	3928	68.22
2011	5789	2760	47.68

The highest densities in 2008-2011 were found in the Northern region Q1, Q2 and Q3 (Tab. 2). Shrimp densities in the remaining southerly offshore areas (Q4-Q6) showed very low densities in all three years.

Tab. 4 shows the biomass of female and males weighted up to total biomass and the abundance of female and males weighted up to total biomass.

The total number of *Pandalus borealis* (males and females) for 2008, 2009, 2010 was estimated to 204, 909, 525 and 514 million respectively. The abundance of males in 2011 is 386 million or 75% of total abundance compared to a male proportion on 64%, 75% and 56% in 2008, 2009 and 2010 respectively.

The demographic structure in East Greenland shows large males with 20 mm CL as the smallest (fig. 2). A calculation of the fishable biomass - as in West Greenland - of individuals equal to and above 17 mm CL has therefore not been calculated.

The female biomass estimates was 942, 2.920, 3.158 and 2586 tons in 2008, 2009, 2010 and 2011 (tab. 4).

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 2011 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 2008-2011 surveys are used. Table 5 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 - 2011. 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 must in correspondence.

Conclusions

The biomass of shrimp in East Greenland in 2011 is estimated to be at the same level as in 2010, but lower than the 2009 estimate. 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

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Table 1. Stratum, area and numbers of station in 2008-2011.

Stratum		Areal	2008	2009	2010	2011
Q1	0001-0200	217	0	0	0	0
	0201-0400	35445	6	21	16	16
	0401-0600	6975	2	1	5	5
Q2	0001-0200	93	0	1	2	2
	0201-0400	7657	4	7	8	5
	0401-0600	1246	2	3	2	3
Q3	0001-0200	3363	2	3	4	2
	0201-0400	22547	5	17	12	13
	0401-0600	9830	5	5	8	6
Q4	0001-0200	1337	0	3	1	2
	0201-0400	7770	5	14	6	8
	0401-0600	2054	2	3	1	2
Q5	0001-0200	469	3	2	2	2
	0201-0400	2785	3	3	2	3
	0401-0600	1819	1	1	2	2
Q6	0001-0200	6307	7	5	5	5
	0201-0400	6130	3	6	4	7
	0401-0600	2063	3	2	1	2
Total areas / stations		118107	53	97	81	85

Table 2. Biomass(tons) and density (t/ km²) in strata (Q1-Q6) 2008-2011.

Biomasse (tons)

Year	Q1	Q2	Q3	Q4	Q5	Q6	Total suvey	Number of hauls
2008	1,591	7	312	4	24	15	1,953	53
2009	6,945	325	1,157	1	1	17	8,446	97
2010	3,814	55	1,882	1	3	2	5,758	81
2011	5,413	0	367	0	0	9	5,789	85

Density (t/km²)

Stratum-Areal/Year	Q1	Q2	Q3	Q4	Q5	Q6	Total suvey	Number of hauls
	42,637	8,996	35,740	11,161	5,073	14,500	118,107	
2008	37	1	9	0	5	1	17	53
2009	163	36	32	0	0	1	72	97
2010	89	6	53	0	1	0	49	81
2011	127	0	10	0	0	1	49	85

Table 3. Biomass in depthstrata (tons and percent).

Stratum		Areal	2008	2009	2010	2011
Q1	0001-0200	217	·	·	·	·
	0201-0400	35445	965	5688	3451	4319
	0401-0600	6975	626	1257	363	1095
Q2	0001-0200	93	·	0	0	0
	0201-0400	7657	7	325	55	0
	0401-0600	1246	0	0	0	0
Q3	0001-0200	3363	0	2	0	36
	0201-0400	22547	102	874	1770	314
	0401-0600	9830	209	281	111	17
Q4	0001-0200	1337	·	0	0	0
	0201-0400	7770	0	0	0	0
	0401-0600	2054	4	1	1	0.4
Q5	0001-0200	469	0	0	0	0
	0201-0400	2785	22	0	3	0
	0401-0600	1819	2	1	0	0
Q6	0001-0200	6307	0	11	1	1.2
	0201-0400	6130	0	4	1	7.2
	0401-0600	2063	15	2	1	0.7
Total areas / stations		118107	1952	8446	5757	5789

Stratum		Areal	2008	2009	2010	2011
Q1	0001-0200	217	·	·	·	·
	0201-0400	35445	49.4%	67.3%	59.9%	74.6%
	0401-0600	6975	32.1%	14.9%	6.3%	18.9%
Q2	0001-0200	93	·	0.0%	0.0%	0.0%
	0201-0400	7657	0.4%	3.8%	1.0%	0.0%
	0401-0600	1246	0.0%	0.0%	0.0%	0.0%
Q3	0001-0200	3363	0.0%	0.0%	0.0%	0.6%
	0201-0400	22547	5.2%	10.3%	30.7%	5.4%
	0401-0600	9830	10.7%	3.3%	1.9%	0.3%
Q4	0001-0200	1337	·	0.0%	0.0%	0.0%
	0201-0400	7770	0.0%	0.0%	0.0%	0.0%
	0401-0600	2054	0.2%	0.0%	0.0%	0.0%
Q5	0001-0200	469	0%	0.0%	0.0%	0.0%
	0201-0400	2785	1.1%	0.0%	0.1%	0.0%
	0401-0600	1819	0.1%	0.0%	0.0%	0.0%
Q6	0001-0200	6307	0.0%	0.1%	0.0%	0.0%
	0201-0400	6130	0.0%	0.0%	0.0%	0.1%
	0401-0600	2063	0.8%	0.0%	0.0%	0.0%
Total areas / stations		118107	1	1	1	1

Table 4. Female and male: biomass (tons) and abundance (‘000000). Weighted up to total biomass.

Biomasse in tons	Female	Males	Total
2008	942	1011	1,953
2009	2920	5526	8,446
2010	3158	2600	5,758
2011	2586	3203	5,789

Biomasse in tons	Female	Males	Total
2008	48%	52%	1953
2009	35%	65%	8446
2010	55%	45%	5758
2011	45%	55%	6034

Abundance weigthed up ('000000)	Female	Males	Total
2008	73	130	204
2009	226	683	909
2010	233	292	525
2011	178	336	514

Abundance weigthed up ('000000)	Female	Males	Total
2008	36%	64%	204
2009	25%	75%	909
2010	44%	56%	525
2011	35%	65%	514

Table 5. Two Greenlandic surveys from 1989-1996 and 2008-2010 for comparision.

Q1-Q2 (North for 65)	Biomass	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
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
2006					
2007					
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

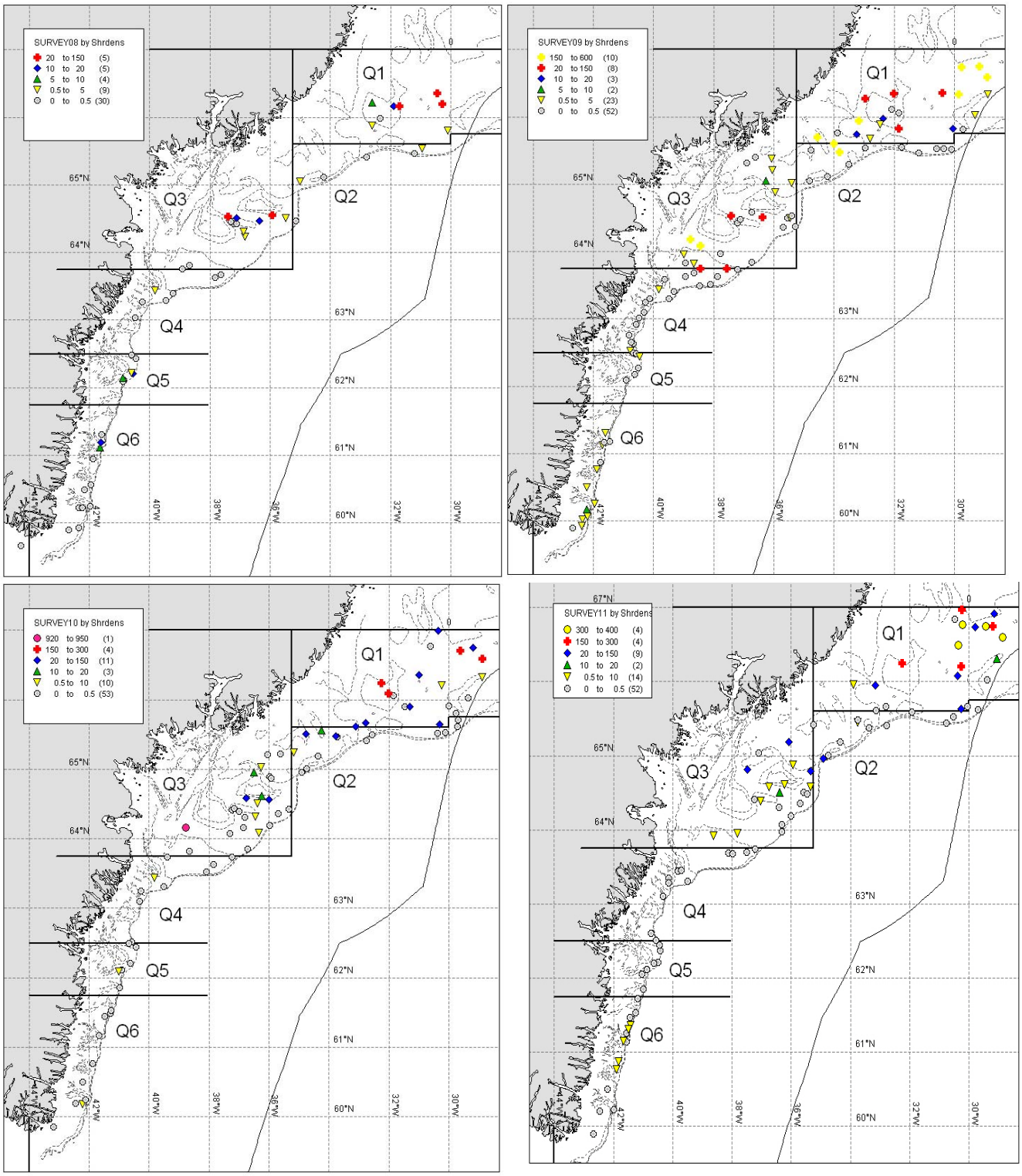

Fig.1. Shrimp densitet in surveyarea in 2008-2011

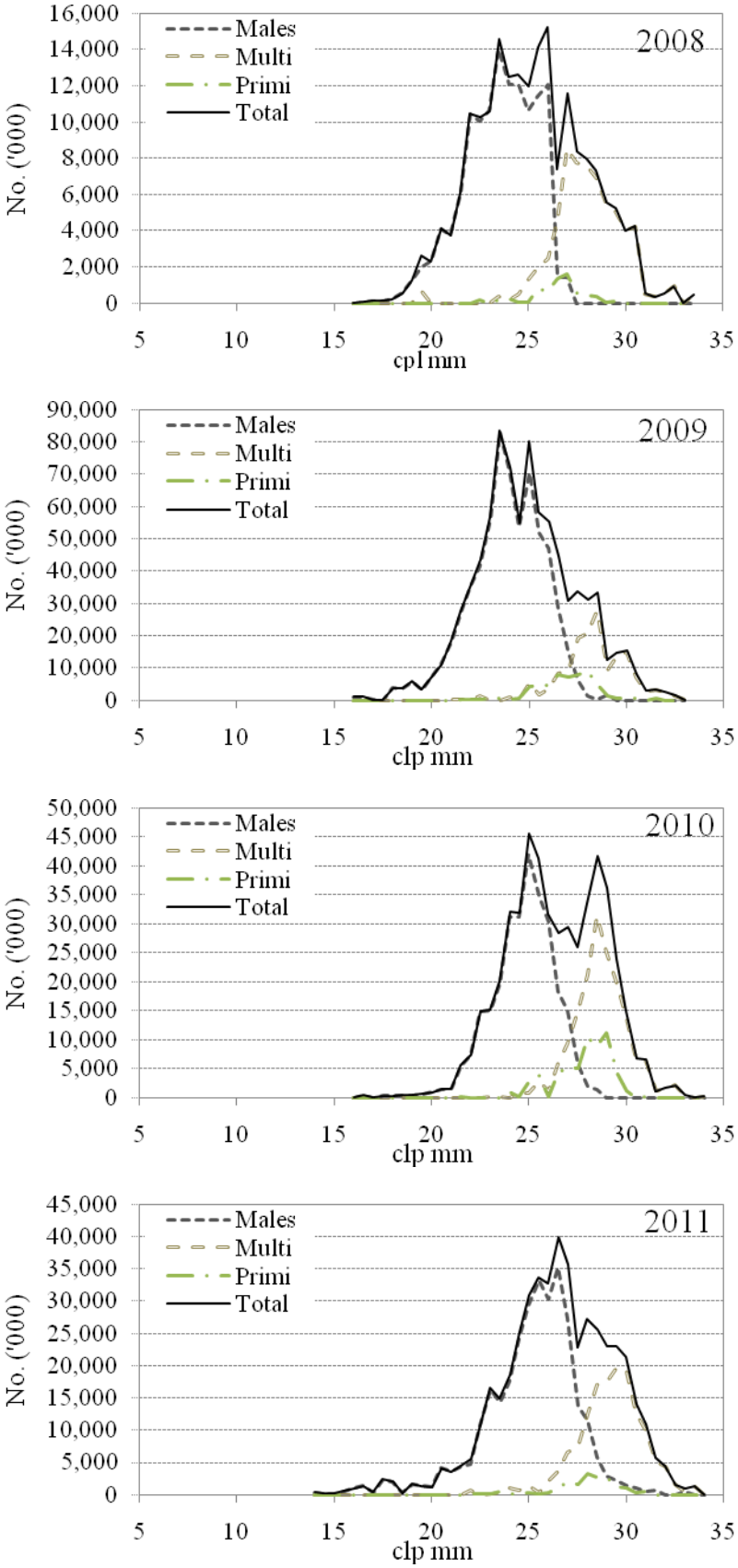

Fig.2. Numbers of shrimp by length group (CL)in the total survey area in 2008-2011, based on pooling of samples weighted by catch and stratum area.

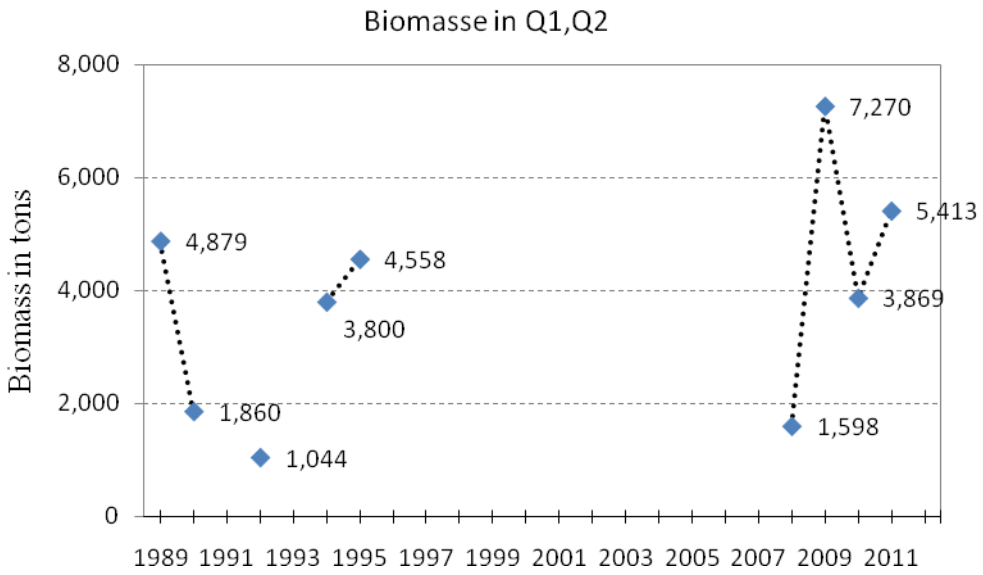

Fig.3. Biomass from two different surveys series from 1989-1995 and 2008-2011 for the areas North of 65°N and stratumarea Q1 and Q2 for comparison.

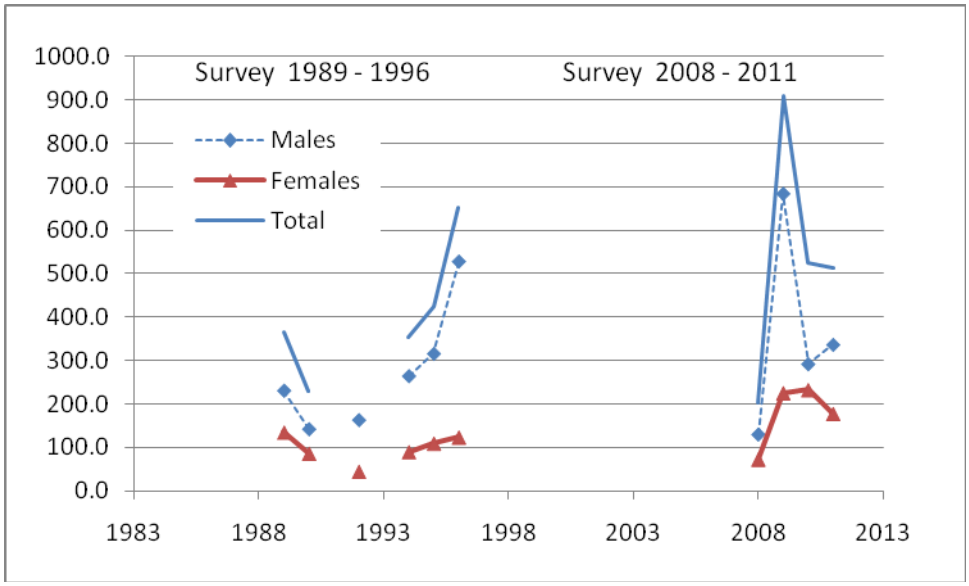

Fig. 4. Abundance of males and females in two different surveys series from 1989-1995 and 2008-2011 for the areas North of 65°N.