Northwest Atlantic Fisheries Organization

Serial No. N5332 **NAFO SCR Doc. 06/82**

NAFO/ICES WG *PANDALUS* MEETING – OCTOBER/NOVEMBER 2006

Results of the Norwegian Bottom Trawl Survey for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa east) in 2006

by

G. Søvik and C. Hvingel

Institute of Marine Research
Box 6404, N-9294 Tromsø, Norway

Abstract

The Norwegian shrimp survey has gone through large changes in recent years. The result is a series of four different surveys, lasting from one to nineteen years. New series were initiated in both 2004 (May) and 2006 (February). Conducting the survey in the 1st quarter will give good estimates of recruitment and SSB. In 2007, the survey will also be conducted in February. Thus, hopefully a new series at the most optimal time of year is established.

There was no trend in the annual survey biomass estimates from the mid 1990s to 2002 when this series was discontinued. The 2004 and 2005 mean value of a new biomass index series were not statistically different. The very low 2006 mean biomass index is to some extent due to the poor geographical coverage of the 2006 survey.

In the 2006 survey a fairly large mode of the 1-group indicates good recruitment of 2-year old shrimp to the fishery in 2007. Reduced abundance of 2-year old shrimp in 2006 was predicted from the 2005 survey due to a small 1-group, while the low abundance of large female shrimp in 2006 is contrary to what was expected from a high abundance of 2-year old shrimp in the 2005 survey (Hvingel 2005). The average shrimp size in the 2006 fishery is therefore expected to be relatively low.

An index of shrimp predator biomass was estimated to 18.3 kg/nm in 2006.

Introduction

Trawl surveys for northern shrimp in Skagerrak and the Norwegian Deep (ICES Div. IIIa and IVa east) have been conducted annually since 1984 with the objective of assessing the size and demographic composition of the shrimp stock, the size of the stocks of shrimp predators, as well as measuring hydrographical conditions in the distributional area of shrimp.

The survey data consist of: 1) one series based on a survey conducted in October/November 1984-2002 using R/V *Michael Sars* and the Campelen-trawl; 2) a point estimate for 2003 as R/V *Michael Sars* was taken out of service and substituted with R/V *Håkon Mosby*, whose winches at that time were not powerful enough for the Campelen-trawl, resulting in the survey being conducted with the Shrimp trawl 1420; 3) a start of a potential new series as the survey in both 2004 and 2005 was conducted in May/June with R/V *Håkon Mosby* using the standard Campelen trawl; and 4) a start of yet a new series in February 2006 still using R/V *Håkon Mosby* and the Campelen trawl.

Conducting the survey in the 1st quarter will give good estimates of the 1-group (recruitment) and SSB (berried females) and was strongly recommended by the *Pandalus* working group in 2004 (ICES 2005). In 2007, the survey will also be conducted in February. Thus, hopefully a new series at the most optimal time of year is established.

This paper presents the results of the 2006 survey.

Material and Methods

Survey design

The design of the new time series (2004-2005 and 2006-) is similar to the old one (1984-2002) (ICES 2005).

The survey area covers depths of 100 to 500 m in ICES Div. IIIa and IVa east. It is stratified by depth in three zones of 100-200 m, 200-300 m and 300-500 m, and area (Table 1, Fig. 1). The total survey area is hereby divided into 16 strata covering 16 560 nm².

The survey is a fixed station design with 100 stations evenly distributed over the survey area (Fig. 2). Ideally, all 100 stations should be trawled every year, giving a coverage of one haul per 1 312 nm^2.

Tow duration was 1 hour until 1989 when it was reduced to 0.5 hour. No compensation for diurnal vertical migrations is made.

In 2006 the survey was carried out 2-15 February using a Campelen 1800/35 bottom trawl with rockhopper gear. Mesh size in the cod end was 22 mm with a 6 mm lining net. A fixed trawl geometry was assumed.

CTD casts were made at each station. The data are not analysed.

Calibration experiments

Calibration experiments were planned for the 2006 survey, where parallel hauls by R/V *Håkon Mosby* (trawling with Campelen) and R/V *G. M. Dannevig* (trawling with the Shrimp trawl 1420) were planned. Data exist from a smaller shrimp survey (16 fixed stations) conducted in March 1988-2003 using R/V *G. M. Dannevig* and the Shrimp trawl 1420. A calibration of the two trawls will enable comparison of recruitment and SSB between the new survey series (2006-) and the old, smaller survey. Unfortunately, time constraints did not allow calibration in 2006, but a new try will be made during the 2007 survey.

Stock size index

The swept area was estimated by applying a wingspread of 11.7 m to tow-length. Tow length was time towed multiplied by an average towing speed of 3 knots. The swept area is thus 0.019 nm^2/hour.

The catch in each tow divided by the swept area represents a sample of shrimp density in a stratum. From these samples the mean and standard error of the density in each stratum was calculated and multiplied by the area of the stratum to give an estimate of stratum biomass and abundance. The means and their standard errors for the 16 strata were summed to give the overall values for the survey area.

A biomass index of shrimp predators were constructed as average catch/nm over all hauls of 22 fish species or species' groupings.

Biological samples

Samples of 250-300 shrimp specimens are taken from each trawl haul, sorted by sexual characteristics, and measured to the nearest mm below (carapace length, CL). The length frequency distribution in the samples was weighted by total catch and stratum area to obtain estimates of the overall distribution, which was partitioned into age groups by modal analysis using the method of Bhattacharya (1967) (software: FISAT).

Results

Area coverage

Due to weather and time constraints and two invalid tows, only 43 tows from the 2006 survey were available for analyses.

Biomass indices

The biomass index increased in the late 1980s to early 1990s, was stable until the mid 1990s where after it started fluctuating at a slightly higher level (Table 2, Fig. 3). This series was discontinued in 2002. The low 2003 biomass index resulted from the use of the Shrimp trawl 1420, with mesh size in the cod end of 36 mm and with no lining. The 2005 mean value is lower than that of 2004, but not statistically different. As the assessment programme calculates the overall mean biomass index as the sum of the strata mean biomasses (Table 2), the very low 2006 value is to some extent due to the low geographical coverage of the 2006 survey, where only 10 out of 16 strata were covered. However, new 2004 and 2005 mean biomass indices calculated for the 10 strata covered in the 2006 survey, were only reduced by 12 and 15% respectively, to 29 930 and 25 730.

Size, age and sex distribution

The size distribution of the 2006 survey shows a fairly large mode at 12.3 mm CL (1-group) (Table 3, Fig. 4), which indicate good recruitment of 2-year old shrimp to the fishery in 2007. Comparison with research survey data from January-March 1988-2003 shows that the proportion of the 2-group (mode at 17.9 mm CL) is lower than expected from the pooled long term data. Reduced abundance of 2-year old shrimp in 2006 was predicted from the 2005 survey due to a small 1-group (Hvingel 2005). However, the abundance of large female shrimp in 2006 (3+ group) is low, contrary to what was expected from a large 2-group mode in the 2005 survey (Hvingel 2005). The average shrimp size in the 2006 fishery is therefore expected to be relatively low.

Predator abundance

The index of shrimp predator biomass was estimated to 18.3 kg/nm in 2006 (Table 4). This is lower than previous indices (ICES 2005, 2006), however, the results from the different surveys are not comparable.

References

Bhattacharya, C. G. 1967. A simple method of resolution of a distribution into Gaussian components. Biometrics 23: 115-135.

Hvingel, C. 2005b. Results of the Norwegian Bottom Trawl Survey for Northern Shrimp (*Pandalus borealis*) in Skagerrak and the Norwegian Deep (ICES Divisions IIIa and IVa) in 2004 and 2005. NAFO SCR Doc. 05/82. 8 pp.

ICES 2005. Report of the *Pandalus* assessment working group, 27 October – 5 November 2004. ICES C.M. 2005/ACFM:05, 74 p.

ICES 2006. *Pandalus* assessment working group report (WGPAND), 26 October – 3 November 2005. ICES CM 2006/ACFM:10. 60 pp.

Table 1. The estimated biomass available to the trawl (Ktons) and abundance (E10) from the Norwegian shrimp survey in the North Sea and Skagerrak 2006 (depth interval in meters; stratum area in nm^2; SE is the standard error).

Stratum	Depth	Area	Hauls	Biomass	SE	Abund.	SE
1	100-200	2794	-	-	-	-	-
2	200-300	1819	-	-	-	-	-
3	100-200	342	-	-	-	-	-
4	200-300	1824	4	2.29	0.79	456	198
5	100-200	1559	-	-	-	-	-
6	200-300	1392	3	2.53	0.88	450	134
7	300-500	860	1	0.20	-	58	-
8	100-200	206	-	-	-	-	-
9	200-300	431	2	0.28	0.23	85	77
10	300-500	299	-	-	-	-	-
11	100-200	400	2	0.20	0.10	77	61
12	200-300	295	5	1.20	0.18	307	88
13	300-500	561	4	1.48	0.68	421	186
14	100-200	1685	8	4.46	1.37	1245	402
15	200-300	957	9	2.22	0.39	659	139
16	300-500	1136	5	1.92	0.87	881	515
Total		16560	43	16.78	0.95	4639	307

Table 2. Estimated biomass indices (tons) in the Norwegian shrimp survey in the North Sea and Skagerrak by survey and stratum 1984-2006 (CV is the coefficient of variation; estimates from the different survey series are not comparable, see text).

Survey		Stratum																Total area	
Year	Series	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Index	CV
1984	1	0	2441	-	2144	4048	3093	1313	-	336	346	316	[1)]556	605	1253	1305	1535	19291	
1985	1	0	4768	-	1162	3288	2607	2016	0	815	475	[1)]1900	794	840	4921	2664	4066	30316	
1986	1	0	2183	-	920	[1)]933	1940	663	-	389	177	[1)]857	540	618	1521	2073	733	13547	
1987	1	88	3765	-	2482	4103	3294	1237	0	1370	254	[1)]1470	584	419	2168	1350	964	23548	
1988	1	0	1126	-	720	373	1079	682	0	294	96	472	391	282	814	777	343	7449	
1989	1	-	932	-	2347	[1)]898	1722	1159	0	560	263	579	556	498	1375	1443	918	13248	
1990	1	0	705	187	3245	[1)]1067	2373	471	0	647	171	1044	559	564	2088	1895	907	15920	
1991	1	0	1903	1008	2612	189	2851	1053	152	725	189	740	526	716	2163	2683	1312	18821	
1992	1	0	615	717	585	136	5743	2299	0	568	527	2091	951	669	3567	2550	1211	22229	
1993	1	0	1481	401	4063	[1)]1487	1437	688	-	621	281	2596	758	728	2735	3823	1237	22336	
1994	1	0	1391	626	2321	345	2439	1992	-	461	255	1627	468	844	3004	2284	1320	19377	
1995	1	0	2794	-	1420	202	4042	953	-	818	236	1836	513	665	2950	2076	1714	20220	
1996	1	0	4901	-	1367	133	3576	1108	-	533	441	3590	616	921	4277	2456	1286	25205	
1997	1	0	7882	-	1995	416	3393	2406	-	764	349	1969	1530	1487	3199	3584	3169	32143	
1998	1	-	5069	-	3357	586	2223	1049	-	682	401	1105	451	529	3186	2439	1378	22455	
1999	1	0	5180	-	5360	3158	3254	1051	-	235	243	475	266	311	4560	2228	1596	27917	
2000	1	-	3436	-	2664	1121	2181	695	-	343	158	939	380	286	4159	2495	1497	20354	
2001	1	-	5180	0	5360	3158	3254	1051	-	307	245	512	266	311	4560	2228	1596	28028	
2002	1	-	[1)]3922	-	[1)]3104	459	3749	1847	-	1153	364	1403	496	411	5425	4470	3329	30133	
2003	2	-	-	-	1410	750	2770	840	300	1240	430	480	770	960	2210	1950	850	14960	
2004	3	-	3590	-	2830	-	3540	1530	-	690	400	120	1390	1230	11060	4650	2890	33920	34 %
2005	3	0	3790	-	5460	0	3160	1900	-	1130	580	1580	570	910	3370	3150	4500	30100	37 %
2006	4	-	-	-	2290	-	2530	200	-	280	-	200	1200	1480	4460	2220	1920	16780	6 %

1) Estimated as an average of the stratum estimates scaled by overall biomass of the year.

Table 3. Mean carapace length (CL) with standard error (SD) and abundance (E10) of age classes 1, 2 and 3+ from the 2006 survey estimate of stock length frequency distribution.

.

age	CL (mm)	SD	proportions	abundance
1	12.34	1.56	0.416	1880
2	17.86	1.55	0.403	1822
3+	21.52	1.89	0.182	822

Table 4. Estimated indices of predator biomass based on catch per nm recorded in the Norwegian shrimp survey in the North Sea and Skagerrak 2006.

Species	kg/nm
Blue whiting	0.1
Saithe	6.6
Cod	0.7
Roundnosed Grenadier	3.6
Rabbit fish	1.8
Haddock	1.1
Redfishes	0.3
Velvet Belly	1.2
Skates, Rays	0.4
Long Rough Dab	0.2
Hake	0.9
Angler	0.2
Witch	0.2
Dogfish	0.3
Whiting	0.4
Blue Ling	0
Ling	0
Fourbearded Rockling	0
Cusk	0.3
Halibut	0
Pollack	0.1
Greater Fork-beard	0
Total	18.3

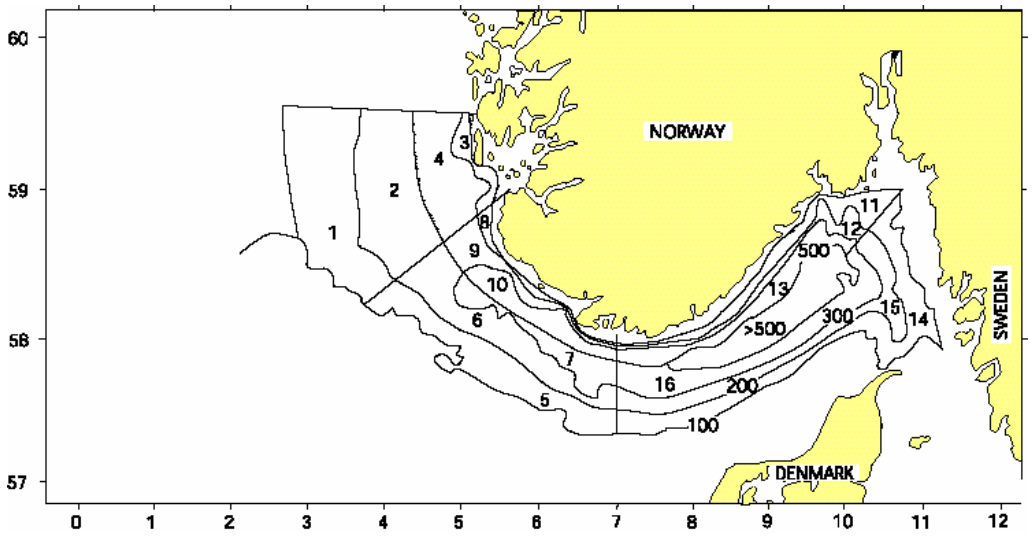

Fig. 1. Stratification used in the Norwegian shrimp survey in the North Sea and Skagerrak.

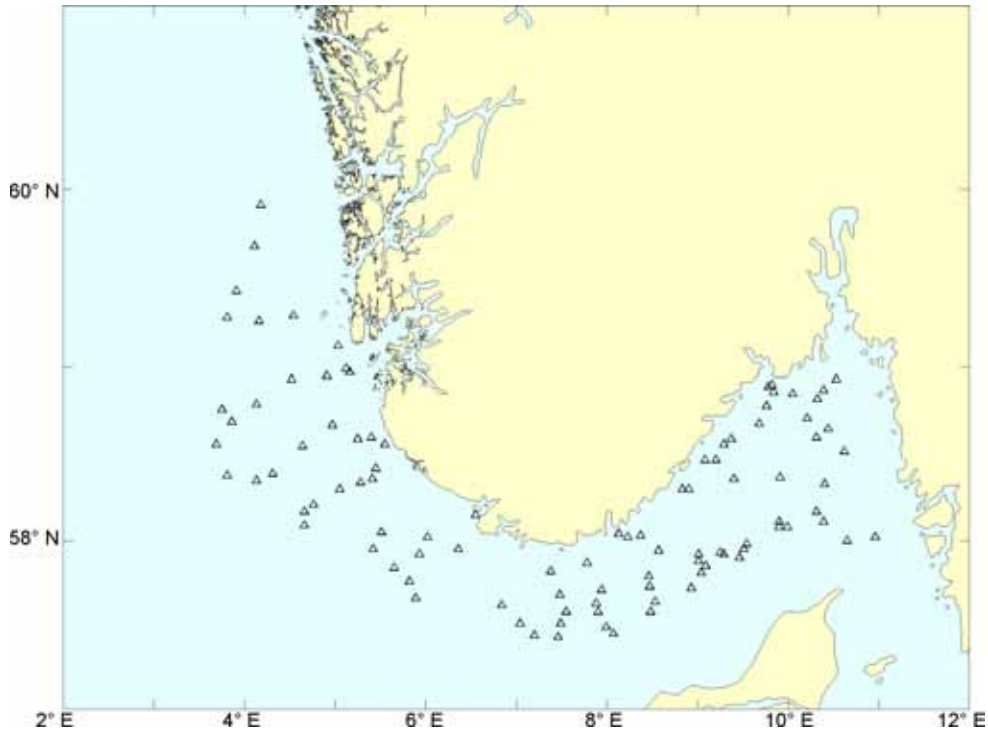

Fig. 2. The 100 fixed trawl stations of the Norwegian shrimp survey in the North Sea and Skagerrak.

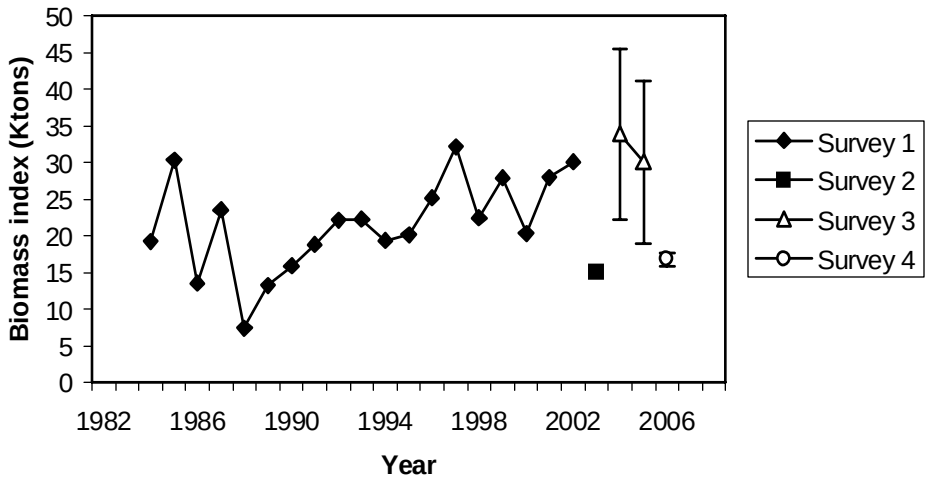

Fig. 3. Estimated survey biomass index of northern shrimp in Skagerrak and the Norwegian Deep. The four surveys are not calibrated to a common scale. Standard errors (error bars) have been calculated for the 2004-2006 surveys.

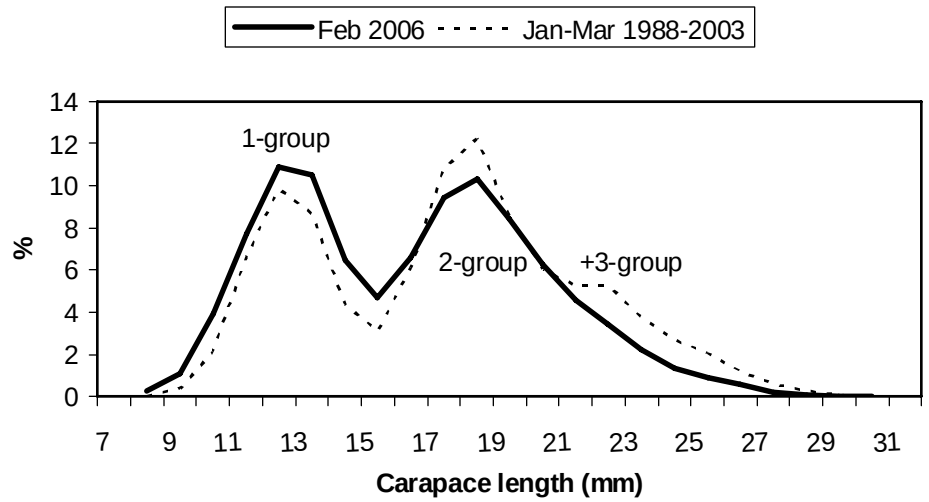

Fig. 4. Estimated length frequency distribution (%) of northern shrimp in Skagerrak and the Norwegian Deep from the 2006 Norwegian shrimp survey, compared with research survey data from Quarter 1 from the same area (using both a commercial-type trawl (36 mm mesh-size) and a research trawl (6 mm mesh-size lining net), data from all years pooled without weighing).