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Research Survey Information Regarding Northern Shrimp (*Pandalus borealis*) in the Barents Sea

by

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**Abstract**

The results of the Norwegian part of the 2004-2006 Ecosystem survey of the Barents Sea showed that the geographical distribution of the shrimp stock seemed stable since 2004 while the estimates of mean shrimp biomass increased by 45% from 2004 to 2006.

Overall size distributions show a relatively large amount of smaller shrimp in 2004, which apparently has fuelled the stock increase in 2005 and 2006. The size distributions of 2005 and 2006 are similar.

The new survey has not been calibrated to the one discontinued in 2004.

**Introduction**

Research surveys have been conducted to assess the stock status of northern shrimp, *Pandalus borealis*, in the Barents Sea. The main objectives were to obtain index values for stock biomass, abundance, recruitment and demographic composition. Recently (since 2004) the monitoring of a multitude of other ecosystem variables has been included in the joint Norwegian-Russian "Ecosystem survey" (www.imr.no).

Three time series exist: (1) The Norwegian shrimp survey 1982-2004 (ICES, 2002a, 2003b, 2005a), (2) The Russian shrimp survey 1984-2002 and 2005 (ICES 2006), (3) The joint Norwegian-Russian ecosystem survey.

This paper presents the results regarding shrimp of the 2004 and 2006 ecosystem surveys.

**Methods**

The ecosystem survey is conducted annually from August to October by 4 vessels covering the entire Barents Sea to the ice edge (Fig. 1). The bottom trawl used is a Campelen 1800 shrimp trawl with rockhopper ground gear. Mesh size in the cod-end was 22 mm with a 6 mm lining. Trawl settings are described in detail in a separate manual for rigging of trawl and trawl equipment (Engås, 1995).

Trawl geometry and behaviour of the trawl were monitored using *Scanmar* trawl sensors. *Steinshamn* trawl doors are used on the Norwegian vessels. "strapping" – a rope 150-180 m in front of the doors locks the distance the trawl doors to approximately 50 m – is used. The towing time is 15 min. GPS positions were used to calculate towed distance. A speed sensor (symmetry) was used on all bottom hauls, giving information about the direction and amount of currents entering the trawl and making it possible to tow at the right speed and geometry in proportion to underwater crosscurrents by adjusting wires or warps to compensate a skewed trawl.

For the calculations done in this paper the data was stratified by depth and area similar to the stratification used for the 1982-2004 "shrimp survey". Evaluations of previous surveys, sampling strategies etc are reported in the ICES reports from AFWG 2002, AFWG 2003 and WGPAND 2004 (ICES, 2002a, 2003b, 2005a.

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. Standard error was calculated as B ∗ 0.985 Cochran (1977) for strata with only one tow. The means and their standard errors for the 16 strata were summed to give the overall values for the survey area.

Samples of 250-300 specimens are taken from each trawl haul, sorted by sexual characteristics, and measured to the nearest mm below (carapace length, cpl, as defined in Allen (1959); McCrary (1971). The length- and sex frequency distribution in the samples was weighted by total catch and stratum area to obtain estimates of the overall distribution.

## Results

The geographical distribution of the stock seemed stable since 2004 (Fig. 2) while the estimate of mean biomass increased by 45% from 2004 to 2006 (Table 1) Fig. 3).

Overall size distributions (Fig. 4) indicate a relatively large amount of smaller shrimp in 2004, which apparently has fuelled the stock increase in 2005 and 2006. The size distributions of 2005 and 2006 are similar.
The new survey has not been calibrated to the one discontinued in 2004.

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**Table 1.** Biomass estimates of shrimp by the Norwegian survey 1, 1982-2004 (means) and survey 2, 2004-2006 (means and standard error). The two series are not inter-calibrated.

| Year | Survey 1 | Survey 2 | SE |
|---|---|---|---|
| 1982 | 327 | | |
| 1983 | 429 | | |
| 1984 | 471 | | |
| 1985 | 246 | | |
| 1986 | 166 | | |
| 1987 | 146 | | |
| 1988 | 181 | | |
| 1989 | 216 | | |
| 1990 | 262 | | |
| 1991 | 321 | | |
| 1992 | 239 | | |
| 1993 | 233 | | |
| 1994 | 161 | | |
| 1995 | 193 | | |
| 1996 | 276 | | |
| 1997 | 300 | | |
| 1998 | 341 | | |
| 1999 | 316 | | |
| 2000 | 247 | | |
| 2001 | 184 | | |
| 2002 | 196 | | |
| 2003 | 212 | | |
| 2004 | 151 | 129 | 23 |
| 2005 | | 145 | 21 |
| 2006 | | 188 | 28 |

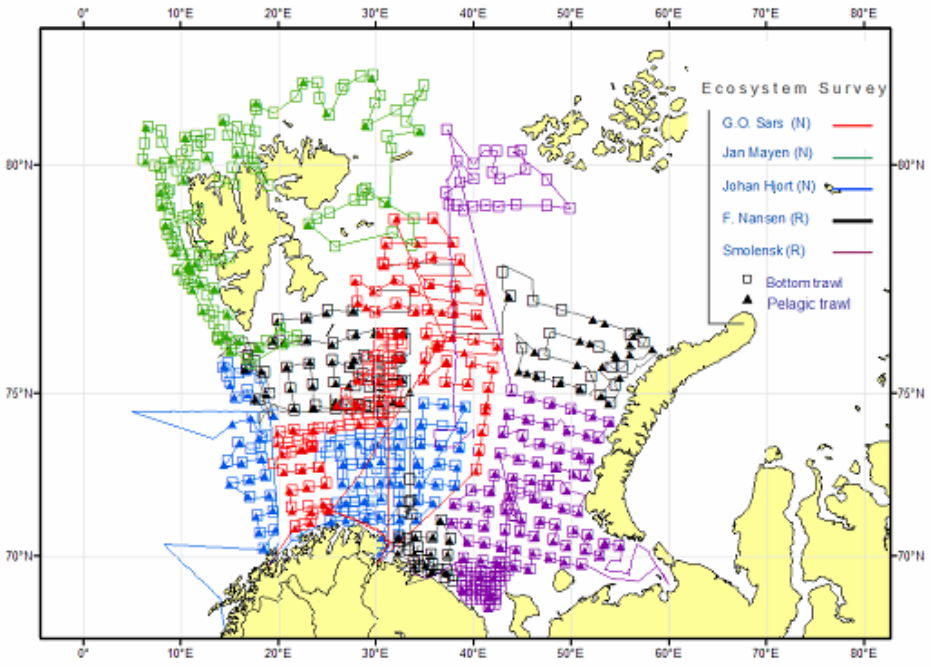


**Fig. 1.** Ecosystem survey trawl stations for "G.O. Sars" "Johan Hjort", "Jan Mayen", "Nansen" and "Smolensk" August - October 2006.

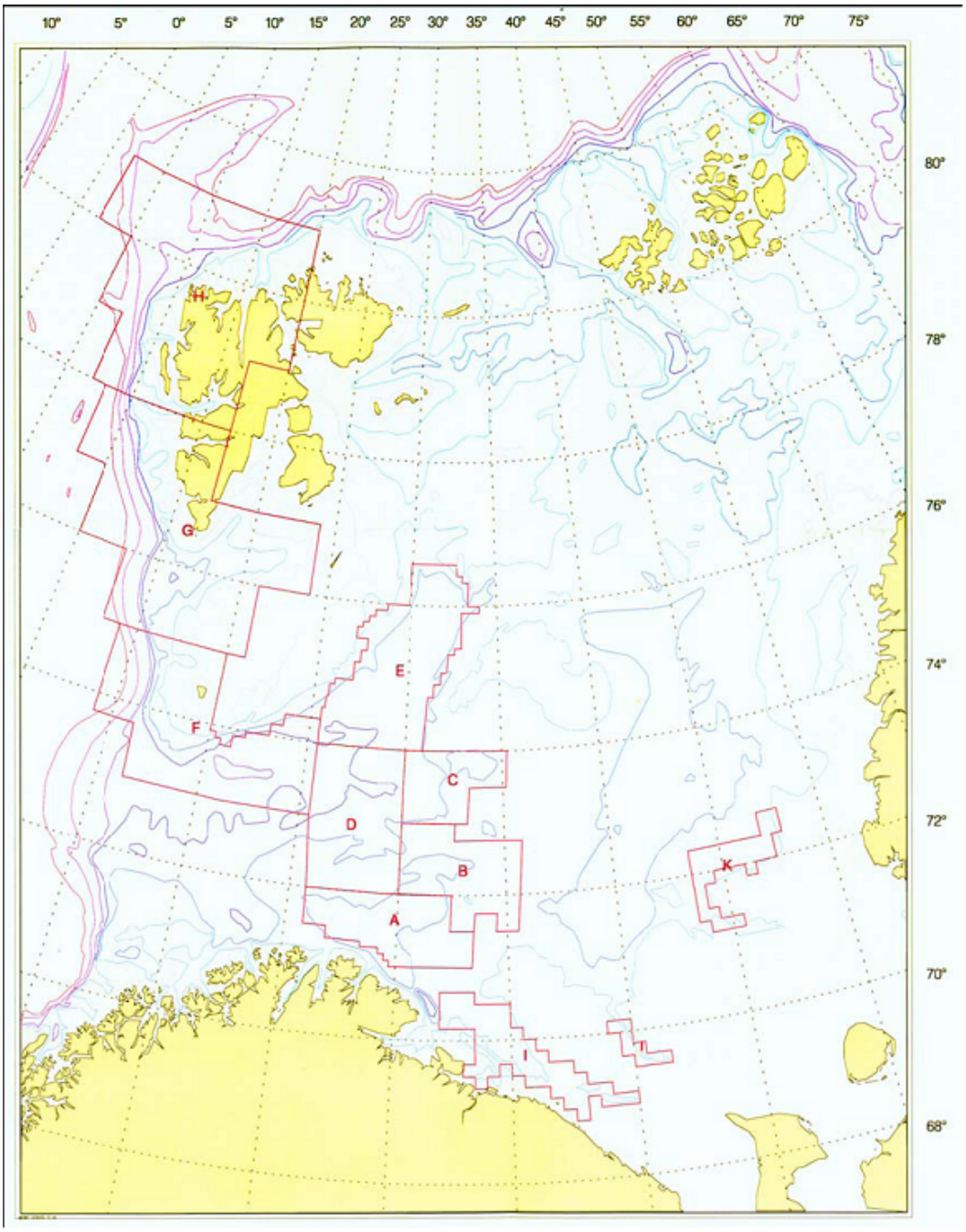


**Fig. 2.** Survey strata used in calculations: East Finnmark (A), Tiddly Bank (B), Thor Iversen Bank (C), Hopen (E), Bear Island (F), Storfjord Trench (G), Spitsbergen (H), Kola coast (I) and the Goose Bank (K) (ICES, 2006).

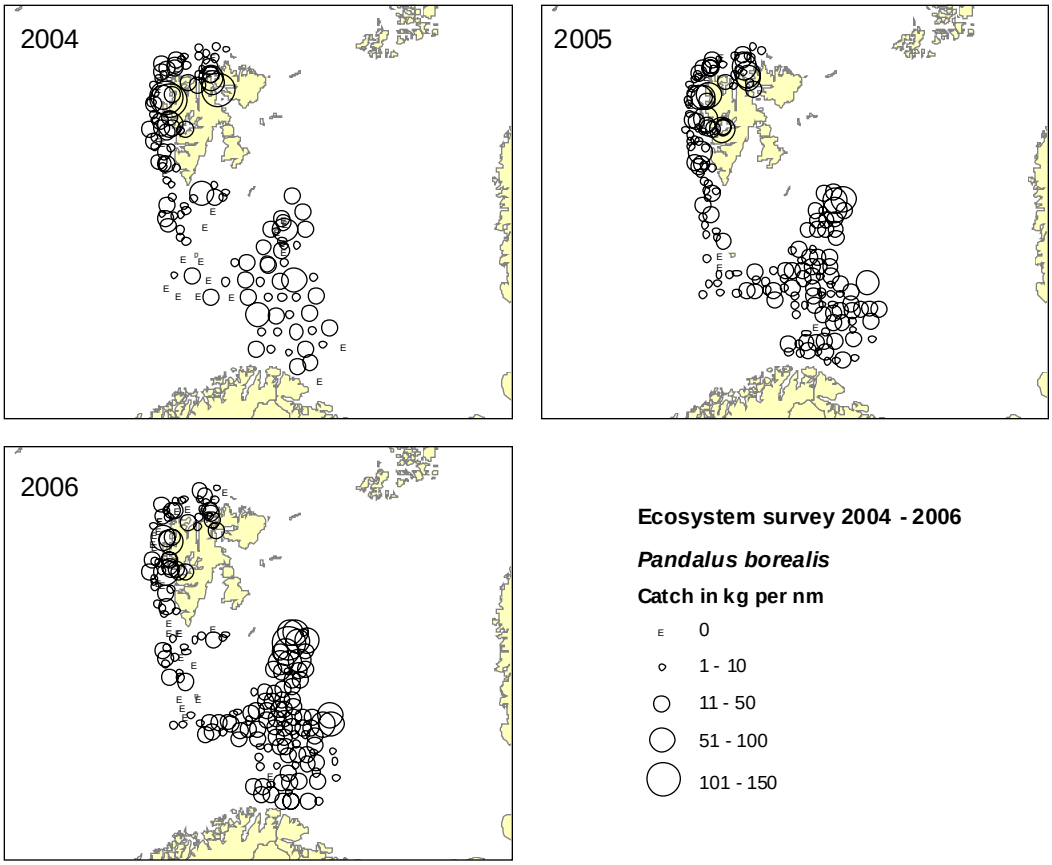


**Fig. 3.** Shrimp density by haul in the Norwegian part of the Ecosystem survey 2004-2006.

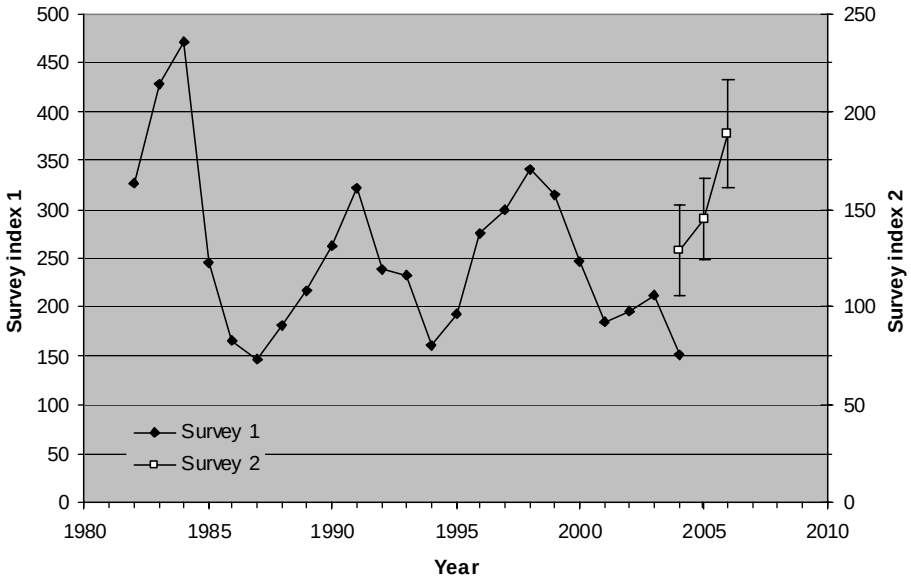


**Fig. 4.** Shrimp stock biomass indices of survey 1 (the shrimp survey) and survey 2 (the ecosystem survey). Note the different scales.

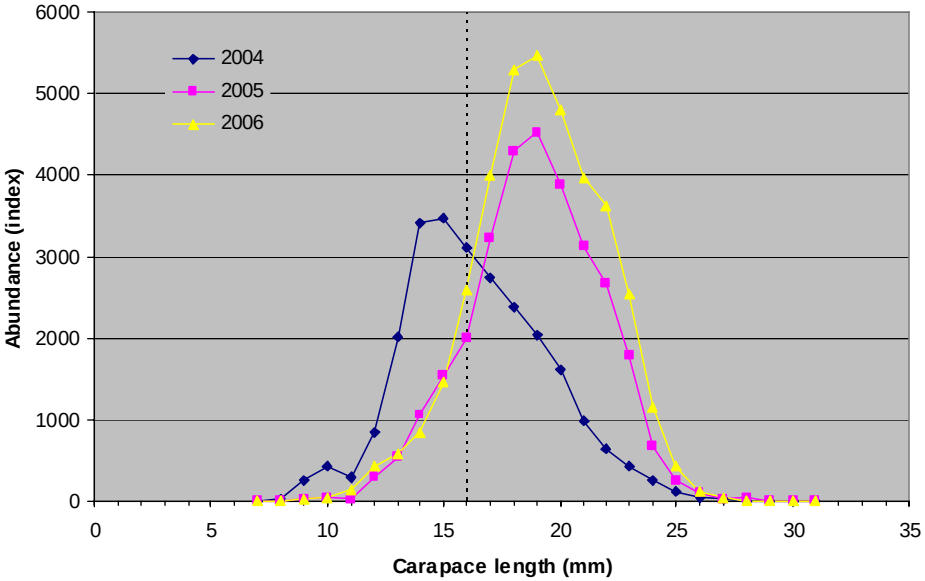


**Fig. 5.** Overall size distribution 2004-2006.