

6.4.16 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Unknown	Unknown	Undefined	NA	

In the absence of defined reference points, the state of the stock cannot be evaluated with regard to biological reference points. The state of the stock is uncertain but abundance indices from Norwegian survey indicate a decrease since 2007. The landings per unit of effort (lpue) indices indicate that the stock has been fluctuating without any clear trends since the mid-1990s. Both Biomass and recruitment (1 year old) indices estimates from the Norwegian survey indicate a decrease since 2007.

Management objectives

There are no explicit management objectives for this stock.

Reference points

No reference points have been established for this stock.

Single-stock exploitation boundaries

ICES advises on the basis of exploitation boundaries in relation to precautionary considerations that the total landings from IIIa and IVa East in 2010 should not be increased above the 2008 level of 13 000 t (corresponding to an estimated catch level of 15000-16000 t).

Management considerations

Following the EU Commission consultation paper on TACs for 2010 (COM(2009) 224, 12 May 2009) this stock would be categorised based on the average stock biomass estimated in the last two years compared to the average of the three preceding years. The relative stock biomass index shows a decrease of 38% from 2006 to 2009. According to EU rules, this should result in a 15% decrease of TAC (14 110 t).

Sorting grids should be mandatory in this fishery in all areas to minimize by-catch. When sorting grids are not used, by-catch species may constitute up to 20% of the landed catch (Table 6.4.16.2) of which saithe and cod are the dominating species. In addition, the shrimp survey indicates that deep-sea species such as Argentines, roundnose grenadier, rabbitfish, and sharks are frequently caught in shrimp trawls in the deeper parts of Skagerrak and the Norwegian Deep. A narrow bar spacing in sorting grids would reduce by-catches of juvenile fish.

The management of this stock should address the discarding of small shrimps, which occurs mainly due to high-grading as a consequence of restrictive TACs. At present the estimated discards amount to around 20% of the total catch (Table 6.4.16.3).

All vessels, including the increasing number of small Norwegian vessels (<11 m), should be required to fill in and deliver logbooks.

Impacts of fisheries on the ecosystems

Shrimp is an important part of the diet for many predators including cod, saithe, and other species.

Factors affecting the fisheries and the stock

Regulations and their effects

The main regulation tool is a TAC, which is not fully fished by all countries. High-grading (discarding of medium-sized low-value shrimp) is documented for the Swedish fishery and in most recent years discarding of small shrimp has been documented also for the Norwegian fishery. The estimated discards are included in the total catch.. Swedish high-grading is reported to be due to quota limitations. Discarding of small sized shrimp may also take place in the Danish fishery, but no data are available at present. Minimum legal mesh size is 35 mm, but an increasing number of shrimp vessels apply up to 45 mm in the cod-end.

Changes in fishing technology and fishing patterns

The number of Danish shrimp vessels has decreased from 191 in 1987 to only 11 in 2008. Mainly small trawlers have left the fishery, with the mean size of the vessels having increased from 20 to 26 m. The efficiency of the gear in the Danish shrimp fishery has increased due to twin trawl technology and increasing trawl sizes.

In the Norwegian fleet the number of small vessels (10–10.99 m) has increased, and this size class is now the most numerous, as a licence to fish is not required for vessels <11 m. In contrast to previous years, quantitative information on gear changes in the Norwegian fleet has become available from interviews with ship owners.

The Swedish fishery has shown an increasing use of trawls equipped with sorting grids.

Impacts of the environment on the fish stock

The natural mortality for *Pandalus borealis* in Divisions IIIa and IVa East is likely to be substantially higher than the fishing mortality and is dependent on the abundance of predators.

Scientific basis

Data and methods

The assessment is based on the evaluation of both Danish (since 1987) and Norwegian (since 2000) standardized lpues, standardized effort, and indices of recruitment and biomass from Norwegian survey (since 2006).

Uncertainties in the assessment

The assessment is indicative of trends only.

The estimate of Danish lpue is based on fishing trips where the landing value of *Pandalus* catches was at least 50% of the landing value of all species. This threshold was selected to ensure the exclusion of trips where *Pandalus* landings can be considered as bycatch rather than a target species.

Comparison with previous assessment and advice

Since 2006 the assessments have been only qualitative and based on trends in standardized LPUEs and abundance indices from surveys. In 2006 and 2007 only Danish lpues were used in the assessment due to low coverage of the Norwegian logbook data. However, since 2008 assessment the Norwegian lpue data have been included in the assessment.

This year advice basis is based on the abundance indices from Norwegian survey which indicates a decrease since 2007..

Source of information

Report of the NAFO/ICES *Pandalus* Assessment Group, Halifax, Canada, 21–29 October 2009 (ICES CM 2000/ACOM:11).

Table 6.4.16.1 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Single stock exploitation boundaries (advice), management and catch.

Year	ICES Advice	Predicted Indgs corresp. to advice ¹	Predicted Indgs corresp. to single-stock exploitation boundaries ¹	Agreed TAC Division IIIa	Agreed TAC Div. IIa + IIIa + IV	Discards.	Landings	ICES catch Disc + Landings
1987	Not assessed					0.7	14.2	14.9
1988	Catches significantly below 1985–1986 ³					0.8	12.2	12.9
1989	No advice			3.1 ¹		1.1	11.1	12.1
1990	F as F(pre-85) ³ ; TAC ³ ; No increase in F ⁴ ;	10.0		2.75 ¹		1.2	10.2	11.4
1991	No increase in F; TAC	12.0		8.55		0.5	11.6	12.1
1992	Within safe biological limits	15 ²		10.50	15.0	0.5	13.0	13.6
1993	Within safe biological limits	13 ²		10.50	15.0	0.9	12.6	13.5
1994	Within safe biological limits	19 ²		12.60	18.0	0.2	11.5	11.7
1995	Within safe biological limits	13 ²		11.20	16.0	0.3	13.4	14.5
1996	No advice	11 ²		10.50	15.0	0.3	14.1	14.5
1997	No advice	13 ²		10.50	15.0	1.0	15.1	16.1
1998	No increase in F; TAC	19 ²		13.16	18.8	0.4	15.4	15.8
1999	Maintain F	19 ²		13.16	18.8	0.6	11.3	11.9
2000	Maintain F	<11.5 ²		9.10	13.0	0.7	11.0	11.5
2001	Maintain F	13.4		10.15	14.5	0.74 ⁶	11.3	11.7
2002	Long-term average landings	12.6		10.15	14.5	0.9 ⁶	12.5	13.4
2003	Maintain F	14.7		10.15	14.5	0.9 ⁶	13.8	14.7
2004	No increase in F ⁵		15.3 ⁵	10.71	15.7	1.8 ⁶	15.9	17.7
2005	No increase in catch above recent level		~13 ⁵	10.71	15.6	1.5 ⁶	14.2	15.7
2006	No increase in catch above recent level		~13.5 ⁵	11.2	16.2	1.2 ⁶	14.2	15.3
2007	No increase in landings above recent level		~14.0 ⁵	11.62	16.6	1.7 ⁶	13.5	15.2
2008	No increase in landings above recent level		~15 ⁵	11.62	16.3	3.4	13.0	16.4
2009	Same advice as last year		~15 ⁵	11.62	16.6			
2010	No increase in landings above 2008 level		~13 ⁵					

Weights in '000 t.

¹ EU zone only.² Catch at *status quo* F.³ Division IIIa.⁴ Division IVa East.⁵ Single-stock boundaries and the exploitation of this stock should be conducted in the context of mixed fisheries protecting stocks outside safe biological limits.⁶ Discards due to Swedish high-grading and Norwegian discards of non-marketable shrimp <15 mm CL (from 2007).

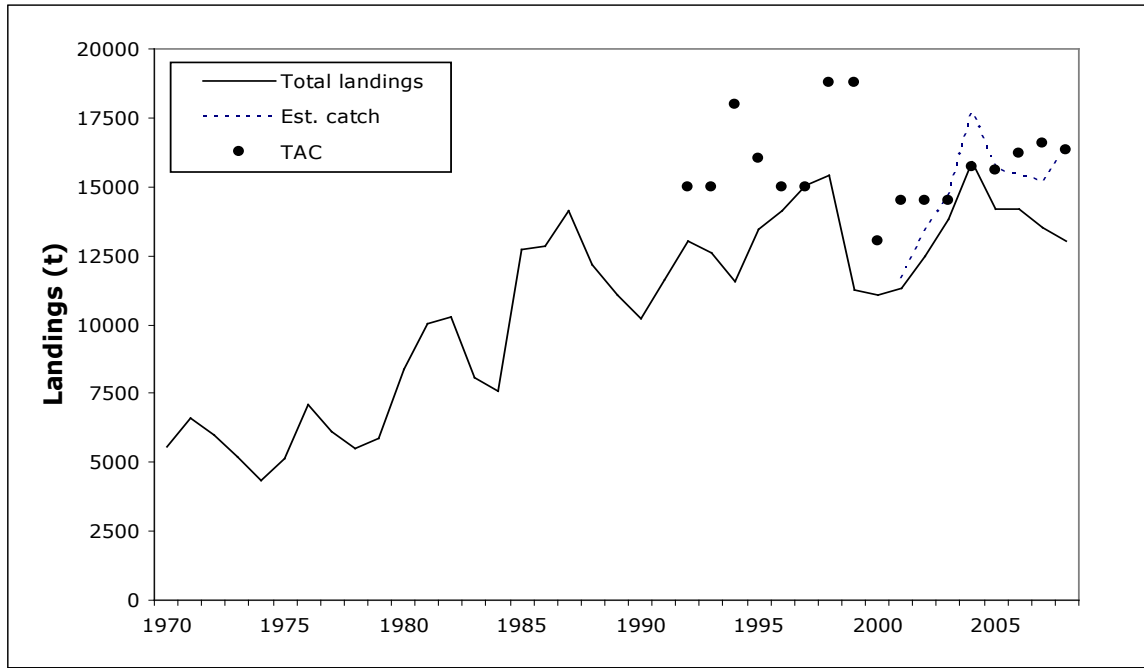


Figure 6.4.16.1 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Landings, TAC, and catches as estimated by ICES.

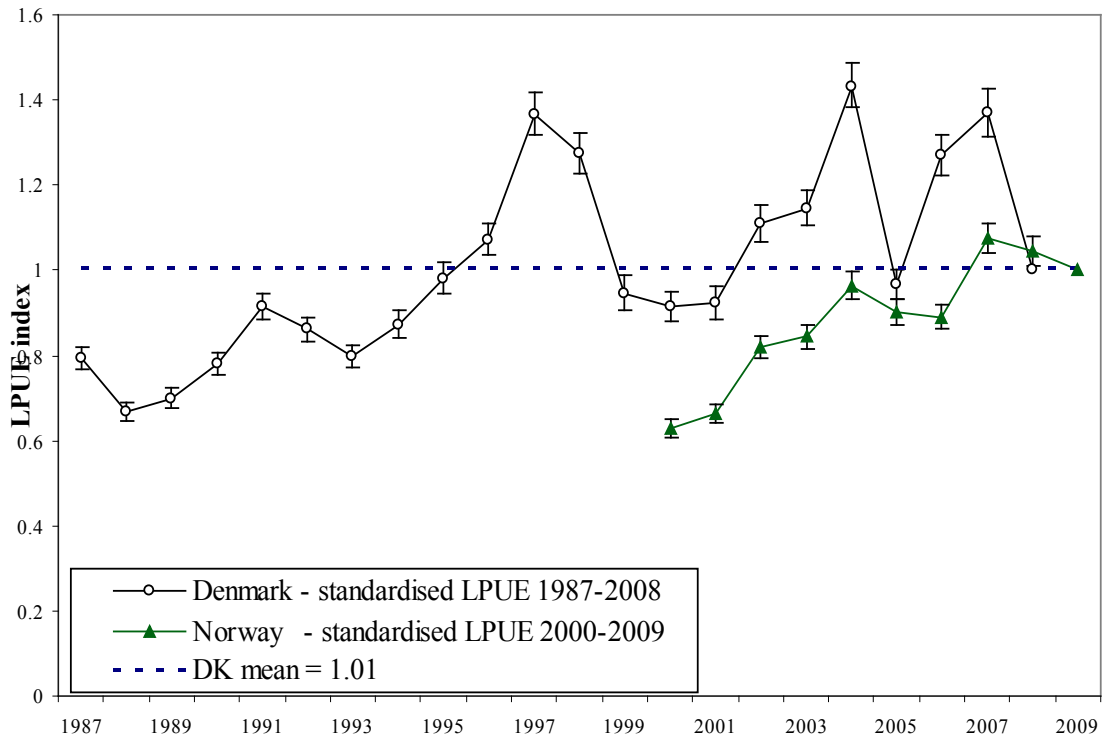


Figure 6.4.16.2 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Danish and Norwegian standardised LPUEs. Error bars are standard errors. Danish 2009 data are not included due to problems with data extraction. Dotted line shows the Danish 1987-2009 mean: 1.01. The Norwegian mean for 2000-2009 is estimated to be: 0.88.

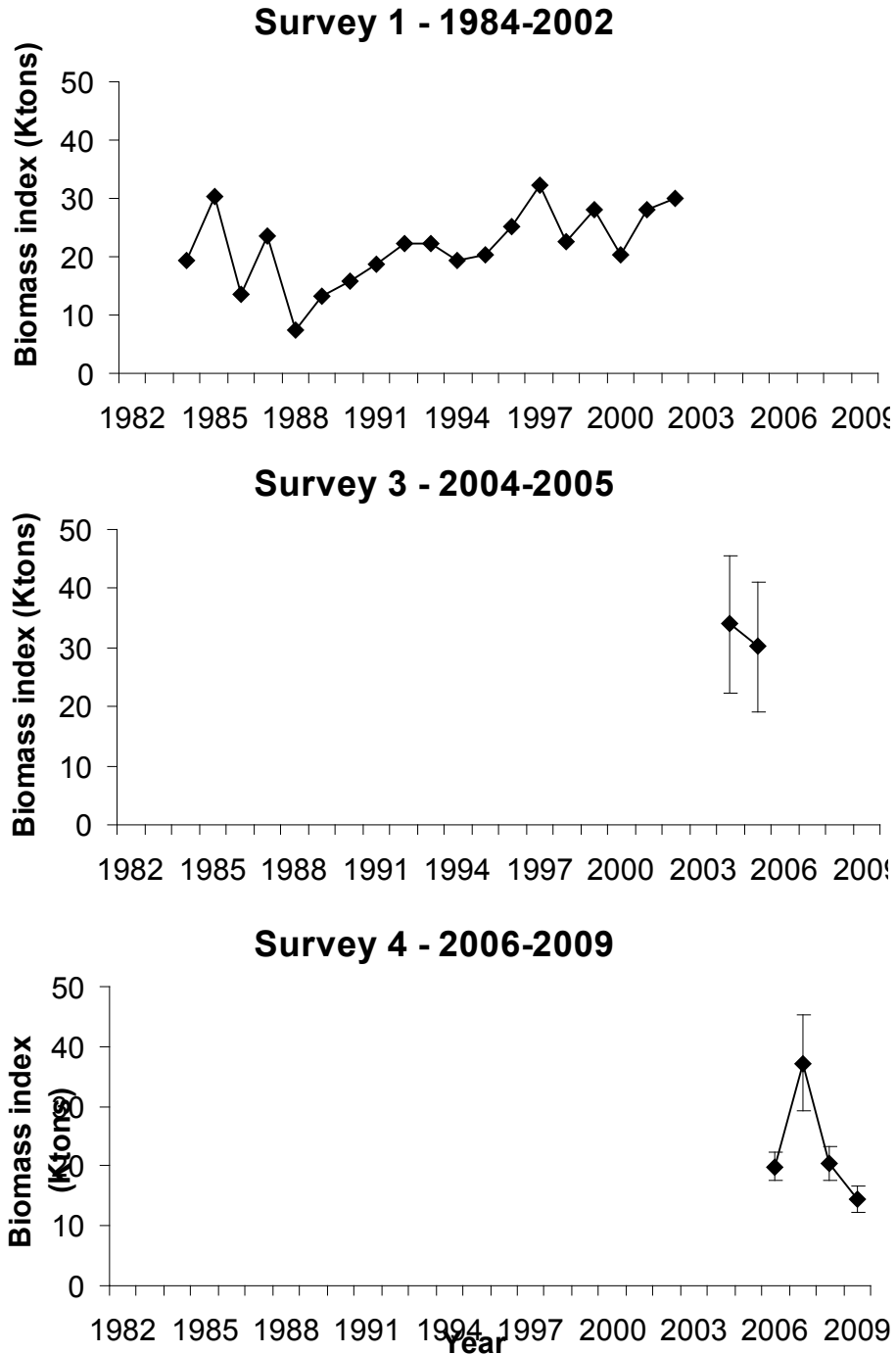


Figure 6.4.16.3

Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Biomass indices estimated from Norwegian surveys.. Results are not comparable because different methodology was used.. Standard errors (error bars) estimated for 2004–2009 surveys.

Survey 1: October/November 1984–2002 with Campelen-trawl; Survey 2: October/November 2003 with shrimp trawl 1420 (not shown); Survey 3: May/June 2004–2005 with Campelen trawl; Survey 4: February 2006–2009 with Campelen trawl.

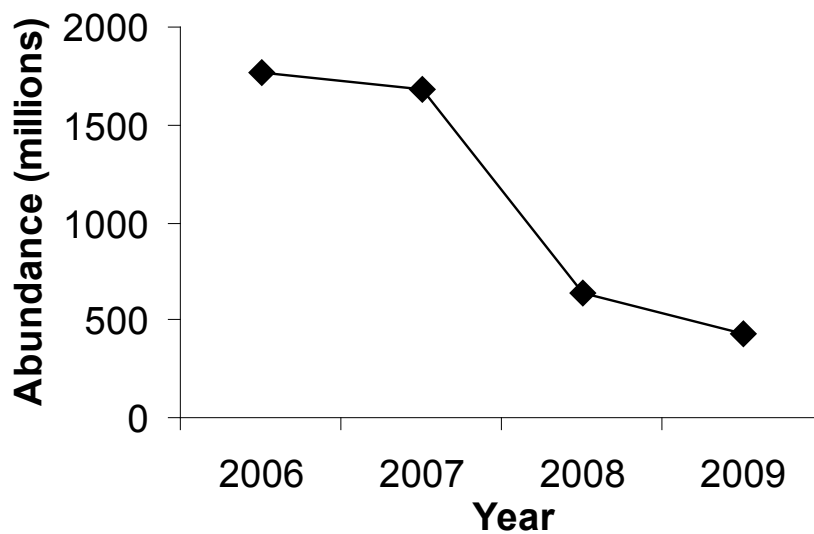


Figure 6.4.16.3 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Recruitment indices from Norwegian shrimp survey. The recruitment index is calculated as the abundance of age 1 shrimp (the first mode in the length–frequency distribution).

Table 6.4.16.2 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Bycatch in the shrimp fishery in 2008. Combined data from Danish and Swedish logbooks and Norwegian landings (tonnes).

Species:	Subdiv. IIIa no grid		Subdiv. IIIa grid		Subdiv. IVa East no grid	
	Total	% of total catch	Total	% of total catch	Total	% of total catch
Pandalus	9606	86.9	634	99.3	2126	77.0
Norway lobster	52	0.5	3	0.5	76	2.8
Angler fish	52	0.5	0	0.0	74	2.7
Whiting	9	0.1	0	0.0	5	0.2
Haddock	78	0.7	0	0.0	24	0.9
Hake	45	0.4	0	0.0	41	1.5
Ling	45	0.4	0	0.0	31	1.1
Saithe	510	4.6	0	0.0	233	8.4
Witch flounder	95	0.9	0	0.0	4	0.1
Norway pout	0	0.0	0	0.0	0	0.0
Cod	399	3.6	0	0.0	101	3.7
Other market fish	164	1.5	0	0.0	46	1.7

Table 6.4.16.3 Northern shrimp (*Pandalus borealis*) in Division IIIa and Division IVa East (Skagerrak and Norwegian Deep). Landings, discards, catches(in tonnes) as estimated by ICES and TACs.

Year	Denmark	Norway *)	Sweden *)	Total landings	Est. SW high grading	Est. NO discards	TAC	Est. catch
1970	1102	1729	2742	5573				
1971	1190	2486	2906	6582				
1972	1017	2477	2524	6018				
1973	755	2333	2130	5218				
1974	530	1809	2003	4342				
1975	817	2339	2003	5159				
1976	1204	3348	2529	7081				
1977	1120	3004	2019	6143				
1978	1459	2440	1609	5508				
1979	1062	3040	1787	5889				
1980	1678	4562	2159	8399				
1981	2593	5183	2241	10017				
1982	3766	5042	1450	10258				
1983	1567	5361	1136	8064				
1984	1800	4783	1022	7605				
1985	4498	6646	1571	12715				
1986	4866	6490	1463	12819				
1987	4488	8343	1322	14153				
1988	3240	7661	1278	12179				
1989	3242	6411	1433	11086				
1990	2479	6108	1608	10195				
1991	3583	6119	1908	11610				
1992	3725	7136	2154	13015			15000	
1993	2915	7371	2300	12586			15000	
1994	2134	6813	2601	11548			18000	
1995	2460	8095	2882	13437			16000	
1996	3868	7878	2371	14117			15000	
1997	3909	8565	2597	15071			15000	
1998	3330	9606	2469	15406			18800	
1999	2072	6739	2445	11256			18800	
2000	2371	6444	2225	11040			13000	
2001	1953	7266	2108	11327	375		14500	11702
2002	2466	7703	2301	12470	908		14500	13378
2003	3244	8178	2389	13811	868		14500	14679
2004	3905	9544	2464	15913	1797		15690	17710
2005	2952	8959	2257	14168	1483		15600	15651
2006	3061	8669	2488	14218	1186		16200	15404
2007	2380	8686	2445	13511	1124	526	16600	15161
2008	2259	8260	2479	12998	2003	1408	16300	16409

*) Swedish and Norwegian landings have been corrected for loss in weight due to boiling.