6.3.17a (update) Northern shrimp (*Pandalus borealis*) in Divisions 3a and 4a East (Skagerrak, Northern North Sea in the Norwegian Deep)

ICES stock advice

Please note: **The present advice replaces the advice given for this stock in October 2015.**

ICES advises that when the MSY approach is applied, catches in 2016 should be no more than 13 721 tonnes. If this stock is not under the EU landing obligation in 2016 and discard rates do not change from the average (2012–2014), this implies landings of no more than 11 869 tonnes.

Stock development over time

The stock size has been above MSY $B_{trigger}$ for most of the time-series, except for the period 2011–2014, and fishing mortality has been above F_{MSY} in the last three years, 2012–2014.

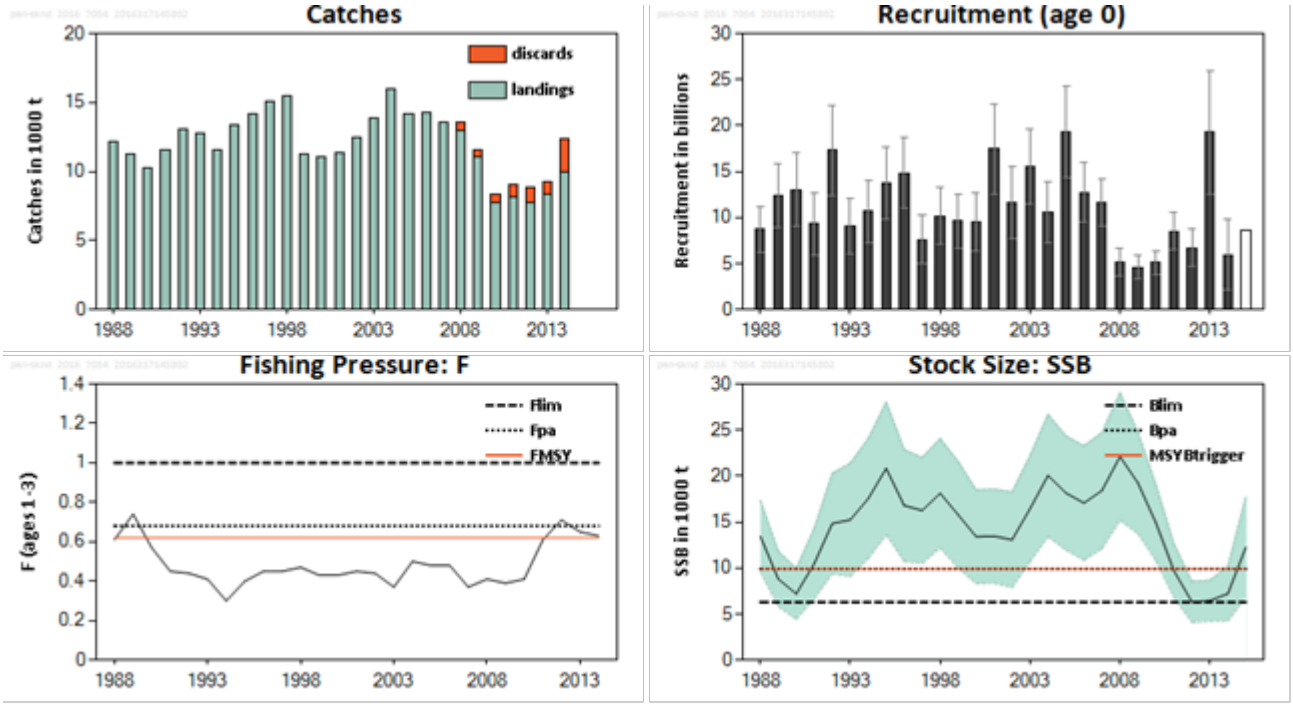

Figure 6.3.17a.1 Northern shrimp in Divisions 3a and 4a East. Summary of the stock assessment. Total catch, including estimated discards since 2008 (tonnes) and F, SSB, and R assessment results. SSB and R depicted with 90% confidence intervals. The assumed recruitment value for 2015 is unshaded.

Stock and exploitation status

Table 6.3.17a.1 Northern shrimp in Divisions 3a and 4a East. State of the stock and fishery relative to reference points.

		Fishing pressure					Stock size				
		2012	2013	2014			2013	2014	2015		
Maximum sustainable yield	F_{MSY}	✗	✗	✗	Above		MSY $B_{trigger}$	✗	✗	✓	Above trigger
Precautionary approach	F_{pa}, F_{lim}	○	✓	✓	Harvested sustainably		B_{pa}, B_{lim}	○	○	✓	Full reproductive capacity
Management plan	F_{MGT}	-	-	-	Not applicable		SSB_{MGT}	-	-	-	Not applicable

Catch options

Table 6.3.17a.2 Northern shrimp in Divisions 3a and 4a East. The basis for the catch options.

Variable	Value	Source	Notes
F_{2015}	0.43	ICES (2015)	Corresponds to the assumed catch in 2015.
SSB_{2016}	15479 t	ICES (2015)	
R_{2016}	8593244 thousands	ICES (2015)	GM 2005–2014
Catch (2015)*	12872 t	ICES (2015)	Equal to landings 2015 plus estimated discards.
Landings (2015)**	11135 t	ICES (2015)	Preliminary landings 2015
Discards (2015)	1738 t	ICES (2015)	Average discard rate in 2012–2014 (13.5%)

* Equal to landings, corrected for weight loss due to on-board boiling and with estimated discards added.
** Landings 2015 are recorded landings (preliminary) corrected by applying a factor of 1.13 to boiled landings to correct for weight loss due to on-board boiling. For Norwegian landings a 50% boiled proportion (proportion in Skagerrak 2013–2014) is assumed as data on proportions of raw/boiled landings are not yet available.

Table 6.3.17a.3 Northern shrimp in Divisions 3a and 4a East. Catch options.

Rationale	Catch (2016)	Wanted catch* (2016)	Unwanted catch** (2016)	Basis	F catch (2016)	SSB (2017)	%SSB change^	%TAC change^^
MSY approach	13721	11869	1852	F_{MSY}	0.62	9959	−36%	+9%
Zero catch	0	0	0	F = 0	0	19250	+24%	−100%
Other options	10711	9265	1446	−15% TAC	0.44	11892	−23%	−15%
	12601	10900	1701	Stable TAC	0.55	10669	−31%	0%
	14491	12535	1956	+15% TAC	0.67	9476	−39%	+15%

* "Wanted catch" is used to describe fish that would be landed in the absence of the EU landing obligation, and has been calculated based on the average discard rates in 2012–2014 (13.5%).
** The "unwanted catch" refers to the component that was previously discarded.
^ SSB 2017 relative to SSB 2016.
^^ Wanted catch 2016 relative to TAC 2015.

Basis of the advice

Table 6.3.17a.4 Northern shrimp in Divisions 3a and 4a East. The basis of the advice.

Advice basis	MSY approach.
Management plan	There is no management plan for Northern shrimp in this area.

Quality of the assessment

Input data are considered to be of good quality. A benchmark took place in January 2016 (ICES, 2016b), which agreed on a length-based model as the basis for the assessment and the provision of catch advice for this *Pandalus* stock. The length-based model is considered preferable to the previous surplus production model because it makes more use of the available data, including using observed lengths to achieve a better representation of the population structure and dynamics. The length-based model is able to better take into account year-to-year changes in recruitment and how these changes influence catch options in the short term.

Discarding practices in the Norwegian fishery are unknown, and Norwegian discards have been estimated by applying the Danish discard ratio to Norwegian data.

Issues relevant for the advice

This advice is a revised version of the advice originally issued in October 2015. In January 2016, a benchmark process took place and a new assessment method and new reference points were agreed. The new assessment model is better able to capture year-to-year changes in stock abundance, in particular in connection with the variable recruitment, and this has substantial

impact on the resulting short-term forecast for 2016. Therefore, ICES has decided to revise the advice in line with the more recent knowledge of this stock.

While there are some differences in assessment results in the present advice with the advice issued in October 2015, the main difference lies in the re-calculation of the reference points, which has resulted in a change in the perception of stock status relative to these reference points. The 2015 assessment indicated that the stock was well within MSY reference points. The current advice indicates that fishing effort for this stock is at F_{MSY} and that the biomass is just above MSY $B_{trigger}$.

Reference points

Table 6.3.17a.5 Northern shrimp in Divisions 3a and 4a East. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	9900 t	5th percentile of equilibrium distribution of SSB when fishing at F_{MSY}, constrained to be no less than B_{pa}.	ICES (2016b)
	F_{MSY}	0.62	The F that maximizes median equilibrium yield (defining yield as the total catch).	ICES (2016b)
Precautionary approach	B_{lim}	6300 t	B_{loss} (lowest observed SSB)	ICES (2016b)
	B_{pa}	9900 t	$B_{lim} \times \exp(1.645 \times \sigma)$, where $\sigma = 0.27$	ICES (2016b)
	F_{lim}	1.00	The F that leads to 50% probability of SSB < B_{lim}	ICES (2016b)
	F_{pa}	0.68	$F_{lim} \times \exp(-1.645 \times \sigma)$, where $\sigma = 0.23$	ICES (2016b)
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

Basis of the assessment

Table 6.3.17a.6 Northern shrimp in Divisions 3a and 4a East. The basis of the assessment.

ICES stock data category	1 (ICES, 2016a).
Assessment type	Quarterly length-based analytical assessment (Stock Synthesis 3) that uses catches in the model and in the forecast.
Input data	Length-frequency distributions from commercial catches and survey. Commercial landings in biomass (until 2007), commercial catches in biomass (since 2008), three survey indices of numbers (Norwegian shrimp surveys 1984–2002, 2004–2005, and 2006–2015).
Discards and bycatch	Discards are included in the assessment (Swedish fleet since 2008, Norwegian and Danish fleets since 2009). Norwegian discards were estimated using the Danish discard ratio.
Indicators	Swedish, Danish, and Norwegian standardized lpues.
Other information	This stock was benchmarked in the beginning of 2016 (ICES, 2016b). A new analytical assessment model and reference points were agreed upon, leading to a revision of the advice for 2016 previously provided by ICES in 2015.
Working group	Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG).

Information from stakeholders

There is no available information.

History of advice, catch, and management

Table 6.3.17a.7 Northern shrimp in Divisions 3a and 4a East. History of ICES advice, the agreed TAC, and ICES estimates of landings. Weights are in thousand tonnes.

Year	ICES advice	Predicted landings corresp. to advice	Predicted catch corresp. to advice	TAC Div. 3a	TAC Norwegian zone Subarea 4 *	Discard estimates	ICES landings	ICES catch (discards and landings)
1987	Not assessed						14.2	
1988	Catches significantly below 1985–1986 catch						12.2	
1989	No advice			3.1 **			11.2	
1990	3a: F as F(pre-1985); 4a East: No increase in F	10.0		2.75 **			10.2	
1991	No increase in F; TAC	12.0		8.55			11.6	
1992	Within safe biological limits	15 ***		10.50	4.500		13.1	
1993	Within safe biological limits	13 ***		10.50	4.500		12.8	
1994	Within safe biological limits	19 ***		12.60	5.400		11.5	
1995	Within safe biological limits	13 ***		11.20	4.800		13.4	
1996	No advice	11 ***		10.50	4.500		14.1	
1997	No advice	13 ***		10.50	4.500		15.1	
1998	No increase in F; TAC	19 ***		13.16	5.640		15.5	
1999	Maintain F	19 ***		13.16	5.640		11.3	
2000	Maintain F	< 11.5 ***		9.10	3.900		11.0	
2001	Maintain F	13.4		10.15	4.350		11.3	
2002	Long-term average landings	12.6		10.15	4.350		12.5	
2003	Maintain F	14.7		10.15	4.425		13.8	
2004	No increase in F	15.3 #		10.71	4.590		16.0	
2005	No increase in catch above recent level	~13 #		10.71	4.590		14.2	
2006	No increase in catch above recent level	~13.5 #		11.2	4.800		14.3	
2007	No increase in landings above recent level	~14.0 #		11.62	4.980		13.6	
2008	No increase in landings above recent level	~15 #		11.62	4.980	0.5	13.0	13.6
2009	Same advice as last year	~15 #		11.62	4.980	0.5	11.1	11.5
2010	No increase in landings above 2008 level	~13 #		9.8	4.200	0.6	7.8	8.3
2011	At least 30% decrease in landings of 2007–2009, reduce discards, mandatory sorting grids	< 8.8		8.3	3.570	0.9	8.2	9.0
2012	Reduce catches and reduce discards	-		7.1	3.035	1.1	7.8	8.8
2013	Reduce landings by 36% and reduce discards	≤ 5.8		6.65	2.850	0.9	8.4	9.3
2014	MSY considerations, reduce discards	≤ 5.426	≤ 6.0	6.65	2.850	2.4	10.0	12.3
2015	MSY considerations, no increase in F, reduce discards	≤ 9.777	≤10.9	7.63	3.270			
2016	MSY approach	≤ 11.869 ##	≤ 13.721					

* TACs in the Norwegian zone of Subarea 4.

** EU zone only.

*** Catch at *status quo* F.

Single-stock boundaries and the exploitation of this stock should be conducted in the context of mixed fisheries, protecting stocks outside safe biological limits.

Wanted catch.

History of catch and landings

Table 6.3.17a.8 Northern shrimp in Divisions 3a and 4a East. Catch distribution by all fleets in 2014 as estimated by ICES.

Total catch (2014)	Landings		Discards
12.340 kt	100% trawl	81% landings	19% discards
	9.953 kt		2.387 kt

Table 6.3.17a.9 Northern shrimp in Divisions 3a and 4a East. ICES landings* in Division 3a and Subarea 4, and ICES estimates of discards and catches (in tonnes). The ICES landings are used in the assessment.

Year	Denmark *	Norway *	Sweden *	Total landings	Estimated Swedish discards	Estimated Norwegian discards**	Estimated Danish discards	Estimated 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	5187	2241	10021				
1982	3766	5422	1450	10638				
1983	1804	5370	1136	8310				
1984	1800	4770	1022	7592				
1985	4498	6550	1571	12619				
1986	4866	6492	1463	12821				
1987	4488	8343	1322	14153				
1988	3240	7659	1278	12177				
1989	3242	6574	1433	11249				
1990	2479	6152	1608	10239				
1991	3583	6104	1908	11595				
1992	3725	7202	2154	13081				
1993	2915	7538	2300	12753				
1994	2134	6814	2601	11549				
1995	2460	8019	2882	13361				
1996	3868	7910	2371	14149				
1997	3909	8568	2597	15074				
1998	3330	9704	2469	15504				
1999	2072	6737	2445	11254				
2000	2371	6442	2225	11038				
2001	1954	7266	2108	11328				
2002	2470	7703	2301	12474				
2003	3270	8177	2389	13836				
2004	3944	9544	2464	15952				
2005	2992	8958	2257	14207				
2006	3111	8669	2488	14268				
2007	2422	8685	2445	13552				
2008	2274	8261	2479	13014	540			13554
2009	2224	6364	2483	11071	337	93	41	11542
2010	1301	4672	1781	7754	386	133	60	8333
2011	1601	4801	1768	8170	504	246	129	9049

Year	Denmark *	Norway *	Sweden *	Total landings	Estimated Swedish discards	Estimated Norwegian discards**	Estimated Danish discards	Estimated catch
2012	1454	4796	1521	7771	683	288	92	8834
2013	2026	5162	1191	8379	265	450	185	9279
2014	2432	6124	1397	9953	572	1289	526	12340

* Swedish (all years), Norwegian (since 2000), and Danish (since 2001) landings have been corrected for loss in weight due to boiling.
** Discarding practices in the Norwegian fishery are unknown, and Norwegian discards have been estimated by applying the Danish discard ratio to Norwegian data.

Summary of the assessment

Table 6.3.17a.10 Northern shrimp in Divisions 3a and 4a East. Assessment summary*. Estimates of spawning-stock biomass and recruitment with 90% confidence intervals.

Year	Recruitment at age 0 (thousands)	High	Low	Stock size: SSB (tonnes)	High	Low	Landings (tonnes)	Discards (tonnes)	Fishing pressure: F ages 1–3 year^{-1}
1988	8733270	11220181	6246359	13465	17347	9582	12177		0.61
1989	12389500	15903088	8875912	8806	11804	5807	11249		0.74
1990	13003000	16981992	9024008	7197	9961	4434	10239		0.57
1991	9316370	12700629	5932112	10499	14322	6676	11595		0.45
1992	17306100	22229980	12382220	14834	20295	9373	13081		0.44
1993	9021520	12016506	6026534	15229	21383	9075	12753		0.41
1994	10668900	14073803	7263997	17543	24062	11024	11549		0.3
1995	13691000	17628423	9753577	20822	28037	13607	13361		0.4
1996	14840300	18719457	10961143	16793	22869	10717	14149		0.45
1997	7590360	10233447	4947273	16254	22003	10506	15074		0.45
1998	10161100	13257319	7064881	18125	24071	12180	15504		0.47
1999	9627430	12577145	6677715	15792	21587	9997	11254		0.43
2000	9475160	12655998	6294322	13404	18490	8317	11038		0.43
2001	17481300	22369319	12593281	13467	18572	8362	11328		0.45
2002	11642900	15529311	7756489	13072	18268	7877	12474		0.44
2003	15497600	19593272	11401928	16447	22213	10680	13836		0.37
2004	10554100	13816908	7291292	20049	26682	13416	15952		0.5
2005	19309200	24259564	14358836	18144	24341	11946	14207		0.48
2006	12738800	16000506	9477094	17063	23283	10842	14268		0.48
2007	11558100	14101764	9014437	18422	24732	12113	13552		0.37
2008	5128690	6594795	3662585	22113	29038	15189	13014	540	0.41
2009	4596500	5902933	3290067	19246	24755	13737	11071	471	0.39
2010	5067890	6406399	3729381	14911	19032	10790	7754	579	0.41
2011	8498740	10530233	6467247	9711	12627	6794	8170	879	0.61
2012	6650420	8684183	4616657	6320	8546	4095	7771	1063	0.71
2013	19225000	25930069	12519931	6447	8670	4225	8379	900	0.65
2014	5949240	9808377	2090103	7209	10183	4236	9953	2387	0.63
2015	8593244*			12262	17727	6796			
Average	**11011276**	**14434281**	**7767384**	**14416**	**19461**	**9371**	**12028**	**974**	**0.483**

* GM 2005–2014.

Sources and references

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