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Northern shrimp (*Pandalus borealis*) in Division 4.a East and Subdivision 20 (northern North Sea, in the Norwegian Deep and Skagerrak)

ICES stock advice

ICES advises that when the MSY approach is applied, catches in 2017 should be no more than 10 316 tonnes.

Stock development over time

The spawning-stock biomass has been below MSY $B_{trigger}$ since 2011, except in 2016. Fishing mortality has been above F_{MSY} since 2011, except in 2015. Recruitment has been below average since 2008, except for the 2013 year class.

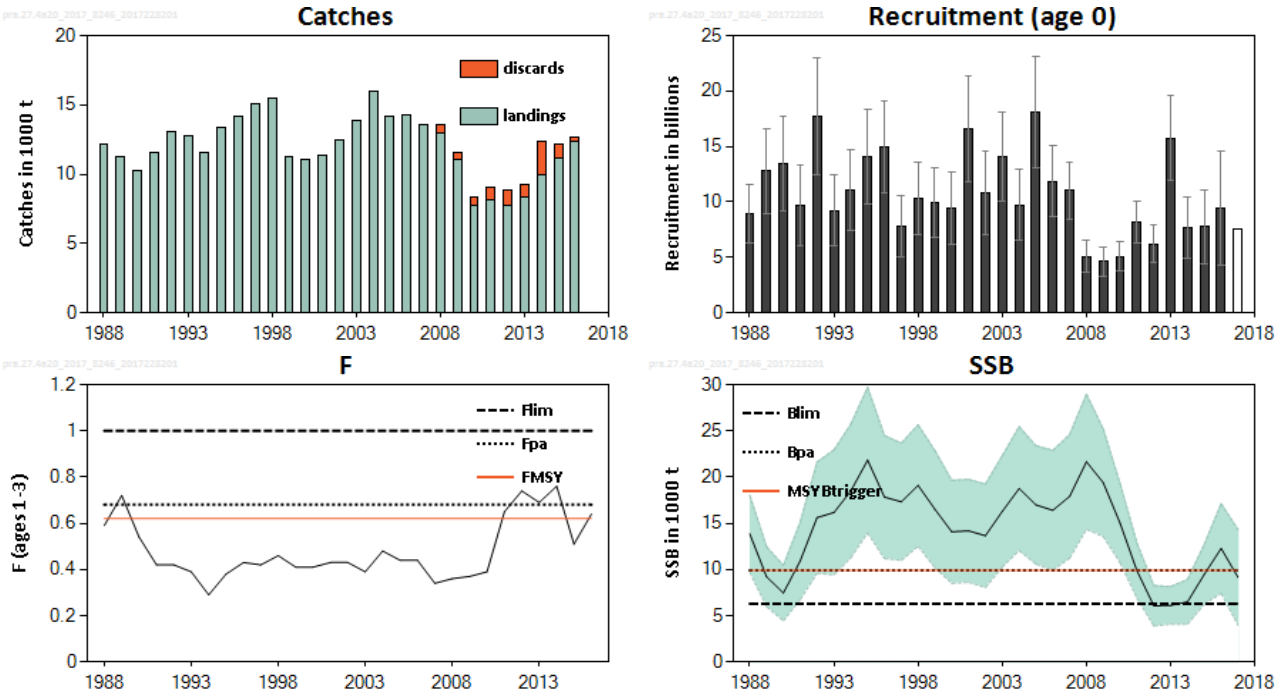

Figure 1 Northern shrimp in Division 4.a East and Subdivision 20. Summary of the stock assessment. Recruitment and SSB are presented with 90% confidence intervals.

Stock and exploitation status

Table 1 Northern shrimp in Division 4.a East and Subdivision 20. State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size			
		2014	2015	2016		2015	2016	2017	
Maximum sustainable yield	F_{MSY}	✗	✓	✗	Above	$MSYB_{Trigger}$	✗	✓	✗ Below trigger
Precautionary approach	F_{pa}, F_{lim}	o	✓	✓	Harvested sustainably	SSB_{pa}, SSB_{lim}	o	✓	o Increased risk
Management plan	F_{MGT}	–	–	–	Not applicable	S_{SBMGT}	–	–	– Not applicable

Catch options

Table 2 Northern shrimp in Division 4.a East and Subdivision 20. The basis for the catch options.

Variable	Value	Source	Notes
F_{2016}	0.64	ICES (2017)	Corresponds to the estimated catches in 2016.
SSB_{2017}	9155	ICES (2017)	In tonnes
R_{2017}	7523007	ICES (2017)	GM 2007–2016 (in thousands)
Catch (2016)	12681	ICES (2017)	In tonnes

Table 3 Northern shrimp in Division 4.a East and Subdivision 20. Annual catch options. All weights are in tonnes.

Basis	Total catch (2017)	F_{total} (2017)	SSB (2018)	% SSB change *	% TAC change **
ICES advice basis					
MSY approach: $F = F_{MSY} \times (SSB_{2017}/ MSY\ B_{trigger})$	10316	0.57	9393	2.6	−34
Other options					
$F = 0$	0	0	16110	76	−100
F_{pa}	11730	0.68	8543	−6.7	−25
F_{MSY}	10979	0.62	8992	−1.78	−30
$F = F_{2016}$	11231	0.64	8840	−3.4	−28
$SSB(2018) = B_{PA} = B_{trigger}$	9484	0.51	9903	8.2	−40
$SSB(2018) = B_{lim}$	15684	1.06	6300	−31	−0.076
F_{MGT}	9548	0.515	9864	7.7	−39

* SSB 2018 relative to SSB 2017.

** Catch in 2017 relative to TACs in 2016.

Basis of the advice

Table 4 Northern shrimp in Division 4.a East and Subdivision 20. The basis of the advice.

Advice basis	MSY approach.
Management plan	There is no agreed management plan for Northern shrimp in this area. A proposed harvest control rule was evaluated by ICES in 2016 (ICES, 2016a) and was found to be precautionary. The proposed management plan is under consideration and not yet adopted.

Quality of the assessment

A benchmark took place in January 2016 (ICES, 2016b), resulting in the adoption of a quarterly length-based model as the basis for the assessment and the provision of catch advice for this *Pandalus* stock. The length-based model is preferred over the previous surplus production model because it uses more of the available data, including observed length distributions and a quarterly time step to achieve a better representation of the population structure and dynamics. The length-based model accounts for variation in recruitment and how these changes influence catch options in the short term.

The abundance indicator from the 2016 Norwegian shrimp survey was not used in the assessment because of a technical issue with the equipment which resulted in asymmetrical wire length of the trawl gear.

Discarding practices in the Norwegian fishery are unknown, and Norwegian discards in Skagerrak have been estimated by applying the Danish discard ratio to the Norwegian data. Norwegian discards are probably underestimated as the proportion of boiled large shrimp found in the Norwegian landings is greater than in the Danish landings.

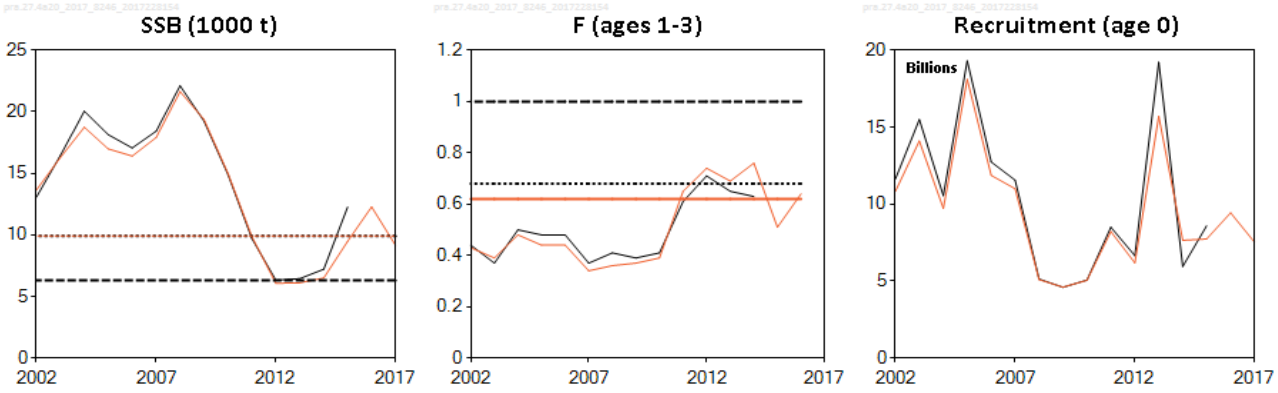

Figure 2 Northern shrimp in Division 4.a East and Subdivision 20. Historical assessment results. The autumn 2016 assessment was postponed to March 2017 and therefore does not appear in the graphs.

Issues relevant for the advice

For 2017, ICES provides only catch advice in accordance with the Norwegian discard ban and the EU landings obligation. Average observed discard rates in the first year of the implementation of the EU landings obligation for this stock (2016) were 2.2%.

ICES conducted an evaluation of a proposed harvest control rule in October 2016 (ICES, 2016a). The proposed rule differed from the ICES MSY advice rule in that it considered the size of the spawning-stock biomass at the end of the TAC year rather than at the beginning of the year. The proposed management plan target F = 0.52 is therefore different from the F_{MSY} (= 0.62) for the stock. The current advice uses the ICES MSY advice rule which implies F_{MSY} = 0.62.

The present advice is based on an assessment that includes the results of the Norwegian shrimp survey in the current (2017) TAC year and full catch statistics from the previous calendar year (2016) (ICES, 2017). The evaluation of the management plan conducted in 2016 was based on assessments being conducted before the TAC year, with one-year-old data for both survey and catch. If the current timing of the advice (March of the TAC year) is maintained, the F target of the proposed management plan would need to be re-evaluated.

Reference points

Table 5 Northern shrimp in Division 4.a East and Subdivision 20. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	9900 t	The 5th percentile of the 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 in the benchmark assessment 2016)	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}			
	F_{mgt}			

Basis of the assessment

Table 6 Northern shrimp in Division 4.a East and Subdivision 20. Basis of assessment and advice.

ICES stock data category	1 (ICES, 2016c).
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 (until 2007), commercial catches (since 2008), Norwegian shrimp survey 1984–2017 (excluding 2003 and 2016).
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 LPUE.
Other information	This stock was benchmarked in January 2016 (ICES, 2016b).
Working group	Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG).

Information from stakeholders

There is no available information.

History of the advice, catch, and management

Table 7 Northern shrimp in Division 4.a East and Subdivision 20. ICES advice and official landings. All weights are in 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						14153	
1988	Catches significantly below 1985–1986 catch						12177	
1989	No advice			3100 **			11249	
1990	3a: F as F(pre-1985); 4a East: No increase in F	10000		2750 **			10239	
1991	No increase in F; TAC	12000		8550			11595	
1992	Within safe biological limits	15000 ***		10500	4500		13081	
1993	Within safe biological limits	13000 ***		10500	4500		12753	
1994	Within safe biological limits	19000 ***		12600	5400		11549	
1995	Within safe biological limits	13000 ***		11200	4800		13361	
1996	No advice	11000 ***		10500	4500		14149	
1997	No advice	13000 ***		10500	4500		15074	
1998	No increase in F; TAC	19000 ***		13160	5640		15504	
1999	Maintain F	19000 ***		13160	5640		11254	
2000	Maintain F	< 11500 ***		9100	3900		11038	
2001	Maintain F	13400		10150	4350		11350	
2002	Long-term average landings	12600		10150	4350		12484	
2003	Maintain F	14700		10150	4425		13845	
2004	No increase in F	15300 #		10710	4590		15956	
2005	No increase in catch above recent level	~13000 #		10710	4590		14207	
2006	No increase in catch above recent level	~13500 #		11200	4800		14268	
2007	No increase in landings above recent level	~14000 #		11620	4980		13555	
2008	No increase in landings above recent level	~15000 #		11620	4980	540	13014	13554
2009	Same advice as last year	~15000 #		11620	4980	467	11069	11536
2010	No increase in landings above 2008 level	~13000 #		9800	4200	572	7754	8326
2011	At least 30% decrease in landings of 2007–2009, reduce discards, mandatory sorting grids	< 8800		8300	3570	874	8169	9043

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)
2012	Reduce catches and reduce discards	-		7100	3035	1051	7827	8878
2013	Reduce landings by 36% and reduce discards	≤ 5800		6650	2850	909	8396	9305
2014	MSY considerations, reduce discards	≤ 5426	≤ 6000	6650	2850	2387	9952	12339
2015	MSY considerations, no increase in F, reduce discards	≤ 9777	≤ 10900	7630	3270	1005	11161	12166
2016	MSY approach	≤ 11869 ##	≤ 13721	10987	4709	283	12397	12680
2017	MSY approach		≤ 10316					
2018								

* 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 the catch and landings

Table 8 Northern shrimp in Division 4.a East and Subdivision 20. Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings	Discards
12680 tonnes	Trawls 100%	283 tonnes
	12397 tonnes	

Table 9 Northern shrimp in Division 4.a East and Subdivision 20. History of commercial catch and landings; ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes.

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				

Year	Denmark*	Norway*	Sweden*	Total landings	Estimated Swedish discards	Estimated Norwegian discards**	Estimated Danish discards	Estimated catch
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	7288	2108	11350				
2002	2470	7713	2301	12484				
2003	3270	8186	2389	13845				
2004	3944	9548	2464	15956				
2005	2992	8958	2257	14207				
2006	3111	8669	2488	14268				
2007	2422	8688	2445	13555				
2008	2274	8261	2479	13014	540			13554
2009	2224	6362	2483	11069	337	94	36	11536
2010	1301	4673	1781	7754	386	133	53	8326
2011	1601	4800	1768	8169	504	247	123	9043
2012	1454	4852	1521	7827	671	292	88	8878
2013	2026	5179	1191	8396	265	459	185	9305
2014	2432	6123	1397	9952	572	1289	526	12339
2015	2709	6808	1644	11161	325	476	204	12166
2016	1997	8305	2095	12397	87	161	35	12680

* 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 10 Northern shrimp in Division 4.a East and Subdivision 20. Assessment summary.

Year	Recruitment age 0	High	Low	SSB	High	Low	Landings	Discards	F ages 1–3
	thousands			tonnes			tonnes		
1988	8916960	11553369	6280551	13858	18024	9692	12177		0.59
1989	12777400	16600808	8953992	9213	12450	5977	11249		0.72
1990	13407400	17694204	9120596	7454	10455	4454	10239		0.54
1991	9655100	13279232	6030968	10942	15130	6753	11595		0.42
1992	17737200	23040976	12433424	15613	21631	9595	13081		0.42
1993	9221000	12392840	6049160	16169	22928	9411	12753		0.39
1994	11039000	14700622	7377378	18486	25705	11266	11549		0.29
1995	14061800	18290075	9833525	21831	29702	13960	13361		0.38
1996	14927500	19084053	10770947	17835	24490	11181	14149		0.43
1997	7816170	10618789	5013551	17324	23667	10982	15074		0.42
1998	10335100	13619688	7050512	19090	25658	12523	15504		0.46
1999	9882710	13021156	6744264	16517	22847	10187	11254		0.41
2000	9474270	12746405	6202135	14074	19637	8511	11038		0.41
2001	16591900	21390381	11793419	14177	19739	8615	11350		0.43

Year	Recruitment age 0	High	Low	SSB	High	Low	Landings	Discards	F ages 1–3
	thousands			tonnes			tonnes		
2002	10839900	14608792	7071008	13651	19246	8056	12484		0.43
2003	14102200	18134046	10070354	16284	22308	10260	13845		0.39
2004	9724430	12900218	6548642	18749	25456	12043	15956		0.48
2005	18107600	23121988	13093212	16986	23384	10588	14207		0.44
2006	11866800	15079238	8654362	16403	22883	9923	14268		0.44
2007	11000300	13529274	8471326	17910	24593	11227	13555		0.34
2008	5091850	6577918	3605782	21648	28948	14348	13014	540	0.36
2009	4605900	5932538	3279262	19381	25191	13571	11071	467	0.37
2010	5050270	6382167	3718373	14994	19258	10730	7754	572	0.39
2011	8218270	10085641	6350899	9866	12834	6898	8170	874	0.65
2012	6179840	7881395	4478285	6070	8250	3890	7771	1051	0.74
2013	15708000	19532625	11883375	6111	8141	4080	8379	909	0.69
2014	7650430	10425512	4875348	6498	8918	4078	9953	2387	0.76
2015	7736890	11072753	4401027	9481	12710	6252	11161	1005	0.51
2016	9437880	14548171	4327589	12274	17122	7425	12397	284	0.64
2017	7523007*			9155	14333	3977			
Average	10622903	14063616	7395975	14268	19521	9015	12012	899	0.48

*Geometric mean 2007–2016.

Sources and references

ICES. 2016a. Norway request on management strategy evaluation for the *Pandalus* fishery in Subdivision 3.a.20 (Skagerrak) and Division 4.a East (Norwegian Deep). *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 3, Section 6.4.2.

ICES. 2016b. Report of the Benchmark Workshop on *Pandalus borealis* in Skagerrak and Norwegian Deep Sea (WKPAND), 20–22 January 2016, Bergen, Norway. ICES CM 2016/ACOM:39. 72 pp.

ICES. 2016c. General context of ICES advice. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.2.

ICES. 2016d. Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 7–14 September 2016, Bergen, Norway. ICES CM 2016/ACOM:15. 116 pp.

ICES. 2017. Update assessment of Northern shrimp (*Pandalus borealis*) in Division 4.a East and Subdivision 20 (northern North Sea in the Norwegian Deep and Skagerrak). *In* Report of the Joint NAFO/ICES *Pandalus* Assessment Working Group (NIPAG), 7–14 September 2016, Bergen, Norway. ICES CM 2016/ACOM:15. Annex 6, pages 101–116.