

Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East (Skagerrak and Kattegat and northern North Sea in the Norwegian Deep)

ICES advice on fishing opportunities

ICES advises that when the EU and Norway long-term management strategy (LTMS) is applied, catches in 2020 should be no more than 8736 tonnes and catches for the first two quarters of 2021 should be no more than 4552 tonnes.

Stock development over time

The spawning–stock biomass (SSB) declined after 2008 and has fluctuated at a lower level since then, slightly above B_{lim} . SSB in 2020 is between $MSY B_{trigger}$ and B_{lim} . Fishing mortality (F) has been around F_{MSY} since 2011 and is below F_{MSY} in 2019. Recruitment has been below average since 2008, except for the 2013 year class.

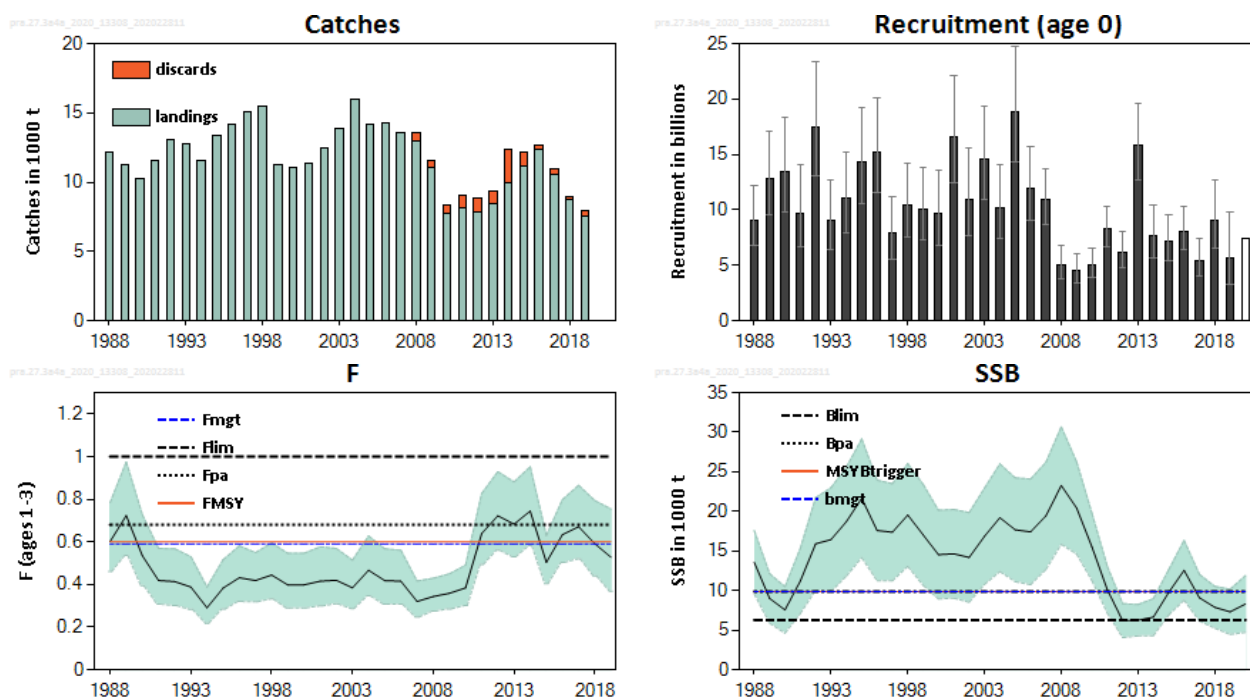


Figure 1 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Summary of the stock assessment. Recruitment, F, and SSB are presented with 90% confidence intervals. Assumed recruitment is unshaded. [Note $B_{MGT} = B_{pa} = MSY B_{trigger}$].

Stock and exploitation status

ICES assesses that current fishing pressure on the stock is below F_{MSY} , F_{MGT} , F_{pa} , and F_{lim} . Spawning–stock size is below $MSY B_{trigger}$ and B_{MGT} , and between B_{pa} and B_{lim} .

Table 1 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. State of the stock and fishery relative to reference points.

		Fishing pressure			Stock size		
		2017	2018	2019	2018	2019	2020
Maximum sustainable yield	F_{MSY}	✘	✔	✔ Below	$MSY B_{trigger}$	✘	✘ Below trigger
Precautionary approach	F_{pa}, F_{lim}	✔	✔	✔ Harvested sustainably	B_{pa}, B_{lim}	○	○ Increased risk
Management plan	F_{MGT}	✘	✔	✔ Below	B_{MGT}	✘	✘ Below

Update for the catch scenarios 2020

Table 2 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Assumptions made in the forecast.

Variable	Value	Notes
F ₂₀₁₉	0.53	From the assessment
SSB ₂₀₂₀	8319	From the assessment; in tonnes
R ₂₀₂₀	7442212	Geometric mean (GM) 2010–2019; in thousands

Table 3 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	F _{total} (2020)	SSB (2021)	% SSB change *	% TAC change **	% advice change ***
LTMS: $F = F_{MGT} \times (SSB_{2020} / MSY B_{trigger})$	8736	0.50	8867	6.6	41.7	41.7
Other scenarios						
MSY approach: $F = F_{MSY} \times (SSB_{2020} / MSY B_{trigger})$	8736	0.50	8867	6.6	41.7	41.7
F = 0	0	0	14940	79.6	-100.0	-100.0
F _{pa}	10932	0.68	7432	-10.7	77.4	77.4
F _{MSY}	9999	0.60	8035	-3.4	62.2	62.2
F _{MSY lower}	7917	0.44	9414	13.2	28.5	28.5
F _{MSY upper}	11362	0.72	7157	-14.0	84.4	84.4
F _{lim}	13997	1	5524	-33.6	127.1	127.1
F ₂₀₁₉	9127	0.53	8607	3.5	48.1	48.1
F _{MGT}	9883	0.59	8111	-2.5	60.4	60.4
SSB ₂₀₂₁ = B _{PA} = B _{trigger}	7198	0.39	9898	19.0	16.8	16.8
SSB ₂₀₂₁ = B _{lim}	12728	0.86	6300	-24.3	106.5	106.5

* SSB₂₀₂₁ relative to SSB₂₀₂₀.

** Advised catch in 2020 relative to TACs in 2019 (6163 tonnes). Note that Norway and Denmark banked 523 tonnes and 245 tonnes, respectively, from 2018. These catches are not included in the TAC change.

*** Advised catch for 2020 relative to the advice value for 2019 (6163 tonnes).

The inclusion of the most recent survey data (2020) and catch data (2019) results in a decline of SSB₂₀₂₀ and a reduction advised catch for 2020 relative to the advised catch given last year for the full year of 2020.

Catch scenarios for first semester in 2021

In order to provide catch advice for 2021, an additional assessment was conducted that assumes catches in 2020 are consistent with the present advice (8736 tonnes). Due to the estimation procedure in the assessment model, this results in slightly different estimates of SSB₂₀₂₁ between Tables 3 and 4.

Table 4 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
F ₂₀₂₀	0.49	From an assessment assuming catches correspond to the LTMS advice for 2020
SSB ₂₀₂₁	9105	SSB at the beginning of 2021, taken from the assessment model and including 2020 catches; in tonnes
R ₂₀₂₁	7464504	GM 2010–2019, taken from the assessment model and including 2020 catches; in thousands
Catches 2020	8736	Catch advice for 2020; in tonnes

Table 5 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2021)	Q1 and Q2 catch (2021) [^]	F _{total} (2021)	SSB (2022)	% SSB change *	% TAC change **	% advice change **
LTMS: $F = F_{MGT} \times (SSB_{2021} / MSY B_{trigger})$	8753	4552	0.54	8206	-9.9	0.2	0.2
Other scenarios							
MSY approach: $F = F_{MSY} \times (SSB_{2021} / MSY B_{trigger})$	8875	4615	0.55	8130	-10.7	1.6	1.6
F = 0	0	0	0	13981	53.6	-100.0	-100.0
F _{pa}	10353	5384	0.68	7229	-20.6	18.5	18.5
F _{MSY}	9461	4920	0.60	7770	-14.7	8.3	8.3
F _{MSY lower}	7472	3885	0.44	9009	-1.1	-14.5	-14.5
F _{MSY upper}	10769	5600	0.72	6981	-23.3	23.3	23.3
F _{lim}	13311	6922	1	5521	-39.4	52.4	52.4
F ₂₀₂₀	8132	4229	0.49	8593	-5.6	-6.9	-6.9
F _{MGT}	9352	4863	0.59	7837	-13.9	7.1	7.1
SSB ₂₀₂₂ = B _{PA} = B _{trigger}	6083	3163	0.34	9899	8.7	-30.4	-30.4
SSB ₂₀₂₂ = B _{lim}	11933	6205	0.84	6300	-30.8	36.6	36.6

* SSB₂₀₂₂ relative to predicted SSB₂₀₂₁.

** Advised catch for 2021 relative to the advised catch for 2020 (8736 tonnes).

[^] Total catch 2021 × average proportion of catch taken in the first two quarters of 2015–2019 (0.52).

The advice is in line with the advice for 2020.

Basis of the advice

Table 6 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. The basis of the advice.

Advice basis	The EU and Norway long-term management strategy (Anon, 2018)
Management plan	In April 2018, a long-term management strategy (LTMS) was agreed by the EU and Norway (Anon., 2018). ICES has evaluated this strategy and found it to be precautionary (ICES, 2017). The LTMS has been in applied since 2019.

Quality of the assessment

The assessment appears to predict particularly well the levels of F and SSB given a certain level of catches. In 2019, at catches equal to the realized catches (i.e. 7944.4 t in 2019), the model predicted an SSB in 2020 only 7% larger than the assessed SSB in 2020 and an F only 2% lower than the assessed F in 2019.

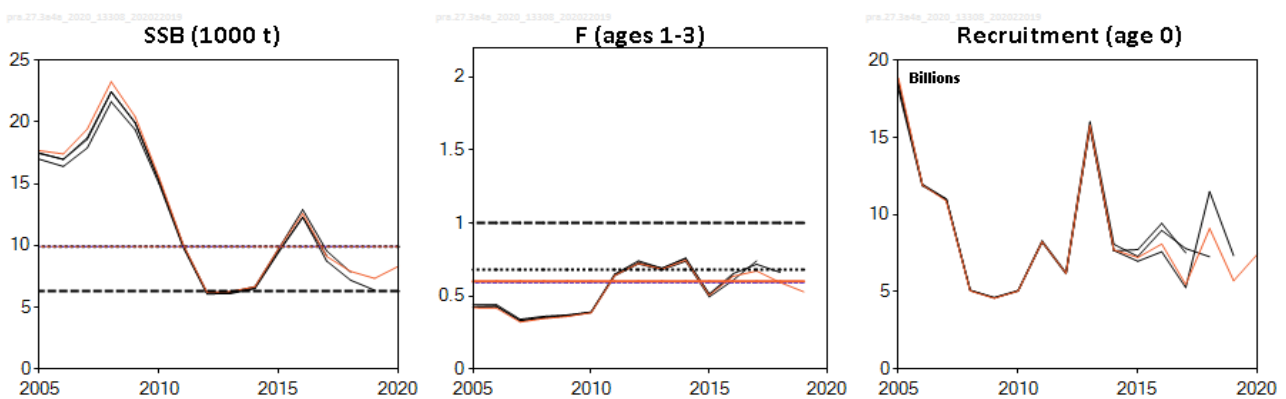


Figure 2 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Historical assessment results. The autumn 2016 assessment was postponed to March 2017 and therefore does not appear in the graphs. (Note: final-year recruitment assumptions are included.)

Issues relevant for the advice

The updated catch advice for 2020 is 30% lower than the initial catch advice (8736 tonnes compared to 12 439 tonnes). The main reason for this change is that the realized catches in 2019 were 29% higher than the advised catches (7944 tonnes realized compared to 6163 tonnes advised). Higher realized catches in 2019 were due to banking from 2018 (768 tonnes), discarding (368 tonnes), lack of correction for the loss in weight due to on-board boiling (ca. 463 tonnes), and exceeding the 2019 TAC by ca. 150 tonnes. Note that the LTMS has been in force from 1 January 2019, and that future banking will only be allowed when the stock is above $MSY B_{trigger}$ (Anon, 2018).

The catch forecast for 2021 depends on the 2020 outtake, which is assumed to be equal to the advised catch (8736 tonnes).

The LTMS assumes that all catches are based on live weight. National catch statistics should be adjusted to take account of the loss in weight due to on-board boiling.

Reference points

Table 7 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. 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 (2016)
	F_{MSY}	0.60	The F that maximizes median equilibrium yield (defining yield as the total catch)	ICES (2017)
Precautionary approach	B_{lim}	6300 t	B_{loss} (lowest observed SSB in the benchmark assessment 2016)	ICES (2016)
	B_{pa}	9900 t	$B_{lim} \times \exp(1.645 \times \sigma)$, where $\sigma = 0.27$	ICES (2016)
	F_{lim}	1.00	The F that leads to 50% probability of $SSB < B_{lim}$	ICES (2016)
	F_{pa}	0.68	$F_{lim} \times \exp(-1.645 \times \sigma)$, where $\sigma = 0.23$	ICES (2016)
Management plan	B_{mgt}	9900	The 5th percentile of the equilibrium distribution of SSB when fishing at F_{MSY} , constrained to be no less than B_{pa}	ICES (2017)
	F_{mgt}	0.59	The F that maximizes median equilibrium yield (defining yield as the total catch), when banking and borrowing is allowed	ICES (2017)

Basis of the assessment

Table 8 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2019).
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 1984–2020 (excluding 2003 and 2016). Boiled landings have been corrected for loss in weight by a factor of 1.13.
Discards and bycatch	Discards are included in the assessment (Swedish values since 2008, Norwegian and Danish values since 2009). Norwegian discards were estimated using the Danish discard ratio until 2016 and using data from the Norwegian reference fleet from 2017 to 2019.
Indicators	Swedish, Danish, and Norwegian standardized landings per unit of effort (lpue).
Other information	This stock was benchmarked in January 2016 (ICES, 2016).
Working group	Joint NAFO/ICES <i>Pandalus</i> Assessment Working Group (NIPAG).

Information from stakeholders

There is no additional available information for this stock.

History of the advice, catch, and management

Table 9 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice	Landings corresp. to advice	Catch corresp. to advice	TAC Division 3.a	TAC Norwegian zone Subarea 4	ICES 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	3.a: F as F (pre-1985); 4.a 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
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

Year	ICES advice	Landings corresp. to advice	Catch corresp. to advice	TAC Division 3.a	TAC Norwegian zone Subarea 4	ICES discard estimates	ICES landings	ICES catch (discards and landings)
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	7221	3095	419	10585	11004
2018	MSY approach		≤ 8571 ^^^	6230	2670	241	8730	8971
2019	Long-term management strategy		≤ 6163 #	4314	1849	368	7577	7944
2020	Long-term management strategy		≤ 8736 ##					
2021	Long-term management strategy		≤ 4552 ###					

* 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.

^^^ Revised from ≤ 10 475 tonnes in March 2018.

Revised from the full-year advice of ≤ 9036 tonnes (4608 tonnes for quarters 1 and 2) issued in November 2018.

Revised from the full-year advice of ≤ 12 439 tonnes (6329 tonnes for quarters 1 and 2) issued in March 2019.

For quarters 1 and 2 only, based on an annual total of 8753 tonnes.

History of the catch and landings

Table 10 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Catch distribution by fleet in 2019 as estimated by ICES.

Catch	Landings	Discards
7944 tonnes	Trawls 100%	Trawls 100%
	7577 tonnes	368 tonnes

Table 11 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. History of commercial catch and landings; ICES estimated values are presented by country. All weights are in tonnes.

Year	Denmark *^	Norway *	Sweden *	Total landings	Estimated Danish discards	Estimated Norwegian discards **	Estimated Swedish 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 Danish discards	Estimated Norwegian discards **	Estimated Swedish 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	36	94	337	11537
2010	1301	4673	1781	7754	53	133	386	8328
2011	1601	4800	1768	8169	123	247	504	9043
2012	1454	4852	1521	7827	88	292	671	8878
2013	2026	5179	1191	8396	185	459	265	9305
2014	2432	6123	1397	9952	526	1289	572	12340
2015	2709	6808	1644	11161	204	476	325	12166
2016	1997	8305	2095	12397	35	161	87	12680
2017	2173	6778	1634	10586	206	114	99	11004
2018	1863	5493	1374	8730	12	115	114	8971
2019	2058	4414	1105	7577	83	178	106	7944

* Swedish (all years), Norwegian (since 2000), and Danish (since 2001) landings have been corrected for loss in weight due to boiling.

** Norwegian discard estimates until 2016 are obtained by applying the Danish discard ratio to Norwegian data and from 2017 to 2019, by using data from the Norwegian reference fleet.

^ Danish estimates include smaller catches from the most northeastern parts of Division 4.b. *Pandalus* from this area are considered to belong to the *Pandalus* stock in divisions 3.a and 4.a East.

Summary of the assessment

Table 12 Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East. Assessment summary. All weights are in tonnes. High and low refers to 90% confidence intervals.

Year	Recruitment Age 0	Recruitment High	Recruitment Low	SSB	SSB High	SSB Low	Landings	Discards	F Ages 1–3	F High	F Low
	thousands										
1988	9097410	12159767	6806287	13574	17578	9571	12177		0.60	0.78	0.46
1989	12770000	17102485	9535041	9015	12140	5891	11249		0.72	0.98	0.54
1990	13455800	18387063	9847062	7570	10503	4636	10239		0.54	0.73	0.39
1991	9709600	14039902	6714885	11225	15336	7114	11595		0.42	0.57	0.31
1992	17503400	23412938	13085458	15911	21745	10077	13081		0.41	0.57	0.30
1993	9028310	12705556	6415334	16445	22999	9890	12753		0.39	0.53	0.28
1994	11000700	15229524	7946105	18714	25587	11841	11549		0.29	0.39	0.22
1995	14302700	19277568	10611672	21655	29150	14160	13361		0.38	0.52	0.28
1996	15232600	20103654	11541788	17598	23940	11256	14149		0.43	0.58	0.32
1997	7864920	11233601	5506424	17377	23500	11253	15074		0.42	0.55	0.32
1998	10393500	14251443	7579923	19551	26032	13071	15504		0.44	0.60	0.33
1999	10040300	13768760	7321475	17051	23423	10678	11254		0.40	0.55	0.29
2000	9633260	13551663	6847846	14547	20142	8952	11038		0.40	0.55	0.29

Year	Recruitment Age 0	Recruitment High	Recruitment Low	SSB	SSB High	SSB Low	Landings	Discards	F Ages 1–3	F High	F Low
	thousands										
2001	16578800	22120621	12425357	14651	20242	9059	11350		0.42	0.58	0.30
2002	10954800	15530156	7727395	14196	19857	8535	12484		0.42	0.57	0.31
2003	14517200	19337789	10898304	16868	22940	10796	13845		0.38	0.51	0.29
2004	10154100	14009121	7359901	19208	26002	12414	15956		0.47	0.63	0.35
2005	18859100	24797227	14342961	17686	24235	11136	14207		0.42	0.57	0.31
2006	11921500	15647339	9082833	17421	24088	10755	14268		0.42	0.56	0.31
2007	10889500	13721946	8641719	19439	26201	12677	13555		0.32	0.42	0.25
2008	5051840	6761554	3774441	23270	30676	15863	13014	540	0.34	0.43	0.28
2009	4577720	6074187	3449930	20436	26251	14622	11069	467	0.36	0.45	0.29
2010	5045210	6542218	3890751	15500	19743	11257	7754	573	0.38	0.49	0.30
2011	8240710	10276979	6607905	10113	13050	7175	8169	874	0.64	0.83	0.49
2012	6196570	8103939	4738125	6211	8356	4066	7827	1051	0.72	0.93	0.56
2013	15785600	19649632	12681416	6274	8250	4298	8396	909	0.68	0.88	0.53
2014	7713240	10408888	5715699	6658	8985	4332	9952	2388	0.74	0.95	0.58
2015	7219970	9583313	5439451	9789	12641	6937	11161	1005	0.50	0.63	0.40
2016	8099140	10255481	6396196	12572	16343	8800	12397	284	0.63	0.80	0.50
2017	5467730	7413247	4032790	9111	12058	6163	10586	419	0.67	0.87	0.52
2018	9102400	12685657	6531288	7904	10542	5266	8730	241	0.59	0.79	0.44
2019	5709390	9762135	3339140	7331	10187	4476	7577	368	0.53	0.75	0.37
2020	7442212*			8319	11901	4737					

* Geometric mean 2010–2019.

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Recommended citation: ICES. 2020. Northern shrimp (*Pandalus borealis*) in divisions 3.a and 4.a East (Skagerrak and Kattegat and northern North Sea in the Norwegian Deep). In Report of the ICES Advisory Committee, 2020. ICES Advice 2020, pra.27.3a4a, <https://doi.org/10.17895/ices.advice.5911>.