

Northern shrimp (*Pandalus borealis*) in subareas 1 and 2 (Northeast Arctic)

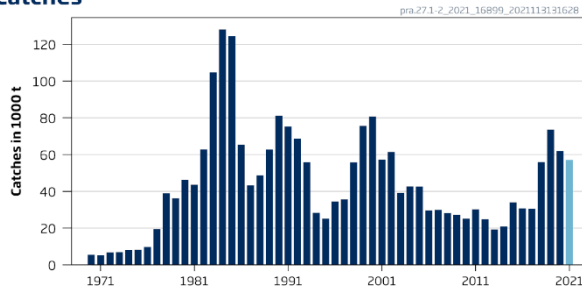
ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 140 000 tonnes.

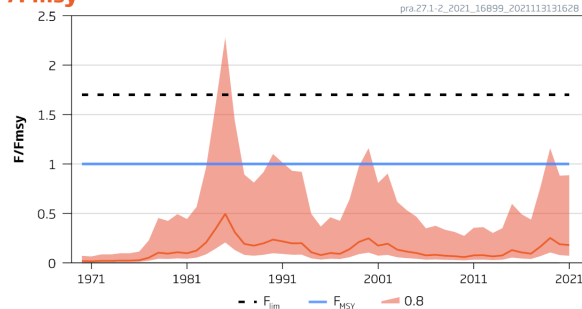
Stock development over time

ICES assesses that fishing pressure on the stock is below F_{MSY} and F_{lim} . Biomass is above MSY $B_{trigger}$ and B_{lim} .

Catches



F/F_{msy}



B/B_{msy}

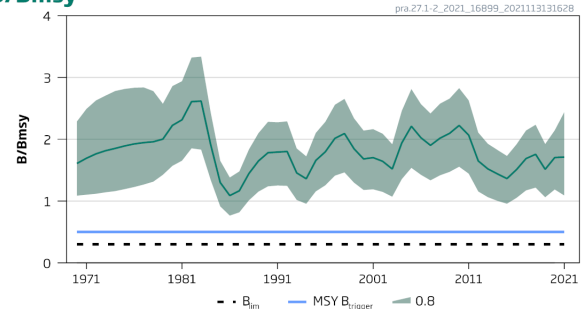


Figure 1 Northern shrimp in subareas 1 and 2. Summary of the stock assessment. Top: total catches (the paler 2021 bar is preliminary estimation). Bottom: biomass and fishing mortality relative to B_{MSY} and F_{MSY} , respectively, and with 80% probability intervals.

Catch scenarios

Table 1 Northern shrimp in subareas 1 and 2. The basis for the catch scenarios.

Variable	Value	Notes
Median F_{2021}/F_{MSY}	0.18	Corresponds to the estimated catch in 2021
Median B_{2021}/B_{MSY}	1.71	B_{2021} is the biomass at the end of 2021, considering the estimated catch in 2021
Catch (2021)	57 000	Based on catch data until September and information from the industry. All catches are assumed to be landed; in tonnes.

Table 2 Northern shrimp in subareas 1 and 2. Annual catch scenarios for 2022.

Basis	Catch scenarios in 2022				
	70 000 t	80 000 t	90 000 t	100 000 t	140 000 t**
Stock size (B_{2022}/B_{MSY}), median	1.71	1.71	1.69	1.69	1.64
Fishing mortality (F_{2022}/F_{MSY}), median	0.21	0.24	0.27	0.31	0.45
Probability of B_{2022} falling below B_{lim}	0.1%	0.1%	0.1%	0.1%	0.3%
Probability of B_{2022} falling below MSY $B_{trigger}$	0.4%	0.4%	0.4%	0.4%	0.7%
Probability of F_{2022} exceeding F_{lim}	2.5%	3.0%	3.8%	4.5%	7.6%
Probability of F_{2022} exceeding F_{MSY}	5.6%	7.1%	8.6%	10.3	17.6%
% advice change*	-50%	-43%	-36%	-29%	0%

* Advice value 2022 relative to the advice value 2021.

** Corresponds to yield at F_{MSY} mode

Basis of the advice

Table 3 Northern shrimp in subareas 1 and 2. The basis of the advice.

Advice basis	MSY approach using the mode of F_{MSY}
Management plan	ICES is not aware of any agreed precautionary management plan for northern shrimp in this area

Quality of the assessment

This year's assessment has resulted in a downwards revision of stock biomass and an upward revision of F compared to last year's assessment (figure 2).

The 2021 survey data from the Russian EEZ (approximately 50% of the entire survey area) was not available in time for the stock assessment. Therefore, for input to the assessment model, the mean proportion (from the entire survey series) of the total biomass within the missing survey strata was used to estimate the total survey biomass for 2021. The incomplete survey data set for 2021 adds uncertainty to the assessment.

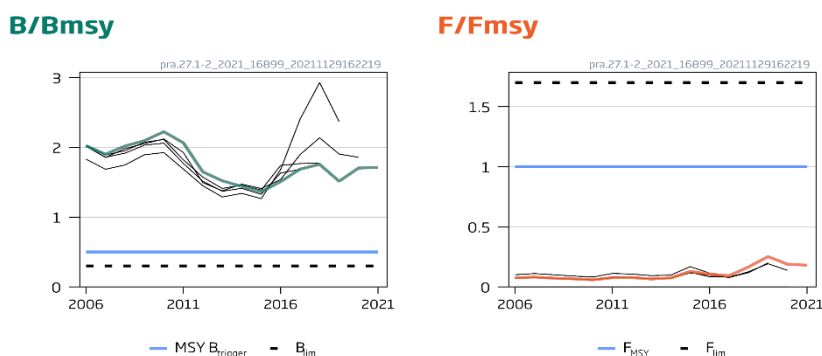


Figure 2 Northern shrimp in subareas 1 and 2. Historical assessment results.

Issues relevant for the advice

The mode of the probability distribution of F_{MSY} is used as the basis for the advice, given the higher uncertainty on the right-hand side of the distribution. Catches corresponding to the fishing mortality at median F_{MSY} would imply catches of over 289 000 tonnes in 2022, constituting a very large extrapolation beyond catches observed in the past. The forecast indicates that the advised catch is sustainable; however, it is above the historical maximum of landings. In this context the mode is the preferred basis for the advice.

Reference points

Table 4 Northern shrimp in subareas 1 and 2. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	$0.5 \times B_{MSY} = 0.25 \times K$ *	Relative value. B_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	ICES (2013)
	F_{MSY}	$r/2$ *	Relative value. F_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	ICES (2013)
Precautionary approach	B_{lim}	$0.3 \times B_{MSY}$	Relative value (equilibrium yield at this biomass is 50% of MSY)	ICES (2013)
	B_{pa}	Not defined	**	
	F_{lim}	$1.7 \times F_{MSY}$	Relative value (the F that drives the stock to B_{lim})*	ICES (2013)
	F_{pa}	Not defined	**	
Management plan	B_{mgt}	Not defined		
	F_{mgt}	Not defined		

* Fishing mortality is presented in relation to F_{MSY} , and total stock biomass is presented in relation to B_{MSY} . K is the carrying capacity and r is the intrinsic biomass growth rate. These values are directly estimated from the stock assessment and change when the assessment is updated.

** B_{pa} and F_{pa} are not defined. The assessment provides probability distributions for B and F , so it is possible to directly estimate the probabilities of $B < B_{lim}$ and of $F > F_{lim}$.

Basis of the assessment

Table 5 Northern shrimp in subareas 1 and 2. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2021a)
Assessment type	Bayesian fitting of a surplus-production model
Input data	Fishery catches 1970–2021. Three survey indices: the Norwegian shrimp survey 1982–2004 [G3653], the Russian shrimp survey 1984–2005 [G4941], and the Norwegian–Russian ecosystem survey (Eco-Norw-Q3 [A5216]) since 2004; one fishery-based index (standardized CPUE from Norwegian logbooks) since 1980.
Discards and bycatch	Discarding is considered to be negligible
Indicators	None
Other information	None
Working group	Joint NAFO/ICES <i>Pandalus</i> Assessment Working Group (NIPAG)

History of the advice, catch, and management

Table 6 Northern shrimp in subareas 1 and 2. ICES advice and official landings. All weights are in tonnes.

Year	ICES advice / Single-stock exploitation boundaries	Catches corresponding to single-stock exploitation boundaries	Agreed TAC	ICES catches
2005	No increase compared to 2004	43600	-	42618
2006	No increase in catch above recent level	40000	-	29627
2007	Catch that will prevent exceeding F_{lim} in the long term	50000	-	29931
2008	Catch that will prevent exceeding F_{lim} in the long term	50000	-	28188
2009	Catch that will prevent exceeding F_{lim} in the long term	50000	-	27272
2010	Catch that will prevent exceeding F_{lim} in the long term	50000	-	25198
2011	Catch that will prevent exceeding F_{MSY} in the long term	60000	-	30226
2012	Catch that will prevent exceeding F_{MSY} in the long term	60000	-	24756
2013	Catch that will maintain stock at current high biomass	60000	-	19249
2014	No new advice, same as for 2013	60000	-	20964
2015	Move exploitation towards F_{MSY}	< 70000	-	34022
2016	Move exploitation towards F_{MSY}	< 70000	-	30749
2017	Move exploitation towards F_{MSY}	≤ 70000	-	30442
2018	MSY approach: move exploitation towards F_{MSY}	≤ 70000	-	56341
2019	MSY approach: move exploitation towards F_{MSY}	≤ 70000	-	76086
2020	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 150000	-	61877
2021	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 140000	-	57000*
2022	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 140000	-	

* Based on catch data until October, and on information from the industry.

History of the catch and landings

Table 7 Northern shrimp in subareas 1 and 2. Catch distribution by fleet in 2020 as estimated by ICES.

Catch	Landings	Discards
61 877 tonnes	100% trawl	Discarding is considered negligible
	61 877 tonnes	

Table 8 Northern shrimp in subareas 1 and 2. ICES catches (tonnes). "Others" are EU, Iceland, Faroes, and Greenland.

Year	Norway	Russia	Others	Total
1970	5508	0	0	5508
1971	5116	0	26	5142
1972	6772	0	0	6772
1973	6921	0	0	6921
1974	8008	0	0	8008
1975	8197	0	2	8199
1976	9752	0	0	9752
1977	14700	0	4854	19554
1978	20484	18270	189	38943
1979	25435	10474	390	36299
1980	35061	11219	0	46280
1981	32713	9886	1011	43610
1982	43451	15552	3835	62838
1983	70798	29105	4903	104806
1984	76636	43180	8246	128062
1985	82123	32104	10262	124489
1986	48569	10216	6538	65323
1987	31353	6690	5324	43367
1988	32021	12320	4348	48689

Year	Norway	Russia	Others	Total
1989	47064	12252	3432	62748
1990	54182	20295	6687	81164
1991	39663	29434	6156	75253
1992	39657	20944	8021	68622
1993	32663	22397	806	55866
1994	20162	7108	1063	28333
1995	19337	3564	2319	25220
1996	25445	5747	3320	34512
1997	29079	1493	5163	35735
1998	44792	4895	6103	55790
1999	52612	10765	12293	75670
2000	55333	19596	5768	80697
2001	43031	5846	8408	57285
2002	48799	3790	8899	61488
2003	34172	2776	2277	39225
2004	35918	2410	4406	42734
2005	37253	435	4930	42618
2006	27352	4	2271	29627
2007	25558	192	4181	29931
2008	20662	417	7109	28188
2009	19784	0	7488	27272
2010	16779	0	8419	25198
2011	19928	0	10298	30226
2012	14158	0	10598	24756
2013	8846	1067	9336	19249
2014	10234	741	9989	20964
2015	16618	1151	16253	34022
2016	10898	2491	17359	30749
2017	7010	3849	19582	30442
2018	23126	12561	20654	56341
2019*	23925	28078	24083	76086
2020 *	19118	21265	21494	61877
2021**	21000	14000	22000	57000

* Preliminary.

** Estimated catches based on reported catches up to October 2021.

Summary of the assessment

Table 9 Northern shrimp in subareas 1 and 2. Assessment summary. Biomass is relative to B_{MSY} at the end of the year and fishing mortality relative to F_{MSY} (median). High and low values are the 80% probability intervals of the distribution. Catches are in tonnes.

Year	B/ B_{MSY}			Total Catch	F/ F_{MSY}		
	Median	High	Low		Median	High	Low
1970	1.61	2.29	1.09	5508	0.0181	0.071	0.0072
1971	1.69	2.49	1.1	5142	0.0160	0.065	0.0063
1972	1.76	2.63	1.12	6772	0.020	0.085	0.0079
1973	1.82	2.71	1.14	6921	0.020	0.085	0.0079
1974	1.85	2.78	1.16	8008	0.023	0.097	0.0089
1975	1.89	2.82	1.19	8199	0.023	0.098	0.0090
1976	1.93	2.83	1.23	9752	0.027	0.115	0.0106
1977	1.95	2.84	1.27	19554	0.052	0.23	0.021
1978	1.96	2.78	1.31	38943	0.103	0.45	0.042
1979	2	2.58	1.43	36299	0.094	0.42	0.039
1980	2.23	2.86	1.57	46280	0.107	0.49	0.045
1981	2.31	2.94	1.65	43610	0.097	0.44	0.041
1982	2.61	3.32	1.85	62838	0.124	0.57	0.052

Year	B/B _{MSY}			Total	F/F _{MSY}		
	Median	High	Low	Catch	Median	High	Low
1983	2.62	3.34	1.83	104806	0.21	0.97	0.086
1984	1.91	2.44	1.34	128062	0.35	1.60	0.144
1985	1.3	1.65	0.91	124489	0.50	2.3	0.21
1986	1.09	1.38	0.76	65323	0.31	1.44	0.129
1987	1.17	1.48	0.82	43367	0.192	0.89	0.080
1988	1.45	1.83	1.01	48689	0.174	0.81	0.072
1989	1.65	2.1	1.15	62748	0.197	0.92	0.082
1990	1.78	2.28	1.24	81164	0.24	1.10	0.097
1991	1.79	2.27	1.25	75253	0.22	1.01	0.090
1992	1.8	2.29	1.25	68622	0.197	0.93	0.082
1993	1.46	1.85	1.02	55866	0.199	0.92	0.083
1994	1.36	1.72	0.96	28333	0.108	0.50	0.045
1995	1.66	2.1	1.16	25220	0.079	0.37	0.033
1996	1.8	2.28	1.25	34512	0.100	0.46	0.041
1997	2.02	2.56	1.41	35735	0.092	0.43	0.038
1998	2.09	2.65	1.46	55790	0.138	0.64	0.057
1999	1.85	2.34	1.3	75670	0.21	0.98	0.089
2000	1.68	2.14	1.18	80697	0.25	1.16	0.104
2001	1.7	2.16	1.19	57285	0.174	0.81	0.072
2002	1.64	2.09	1.15	61488	0.194	0.90	0.080
2003	1.52	1.92	1.07	39225	0.134	0.62	0.056
2004	1.94	2.46	1.36	42734	0.114	0.53	0.047
2005	2.21	2.81	1.54	42618	0.100	0.47	0.041
2006	2.02	2.57	1.43	29627	0.076	0.35	0.032
2007	1.9	2.42	1.34	29931	0.081	0.38	0.034
2008	2.02	2.58	1.42	28188	0.072	0.33	0.030
2009	2.1	2.66	1.47	27272	0.067	0.31	0.028
2010	2.22	2.83	1.56	25198	0.059	0.27	0.024
2011	2.07	2.63	1.44	30226	0.076	0.36	0.032
2012	1.65	2.11	1.16	24756	0.077	0.36	0.032
2013	1.52	1.93	1.06	19249	0.065	0.30	0.027
2014	1.44	1.83	1	20964	0.075	0.35	0.031
2015	1.36	1.73	0.96	34022	0.129	0.60	0.054
2016	1.51	1.92	1.05	30748	0.106	0.49	0.044
2017	1.69	2.14	1.17	30441	0.093	0.44	0.039
2018	1.76	2.23	1.22	55941	0.166	0.77	0.069
2019	1.51	1.92	1.06	73582	0.25	1.16	0.105
2020	1.7	2.15	1.19	61877	0.188	0.88	0.078
2021	1.71	2.44	1.09	57000*	0.180	0.89	0.071

* Estimated catches based on reported catches up to October 2021.

Sources and references

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[Download the stock assessment data and figures.](#)

Recommended citation: ICES. 2021. Northern shrimp (*Pandalus borealis*) in subareas 1 and 2 (Northeast Arctic). *In* Report of the ICES Advisory Committee, 2021. ICES Advice 2021, pra.27.1-2, <https://doi.org/10.17895/ices.advice.7833>.