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

ICES stock advice

ICES advises that when the MSY approach is applied, with additional precautionary considerations, catches in 2017 should be no more than 70 000 tonnes. All catches are assumed to be landed.

Stock development over time

Throughout the history of the fishery, estimates of stock biomass have remained above MSY $B_{trigger}$ and fishing mortality below F_{MSY}.

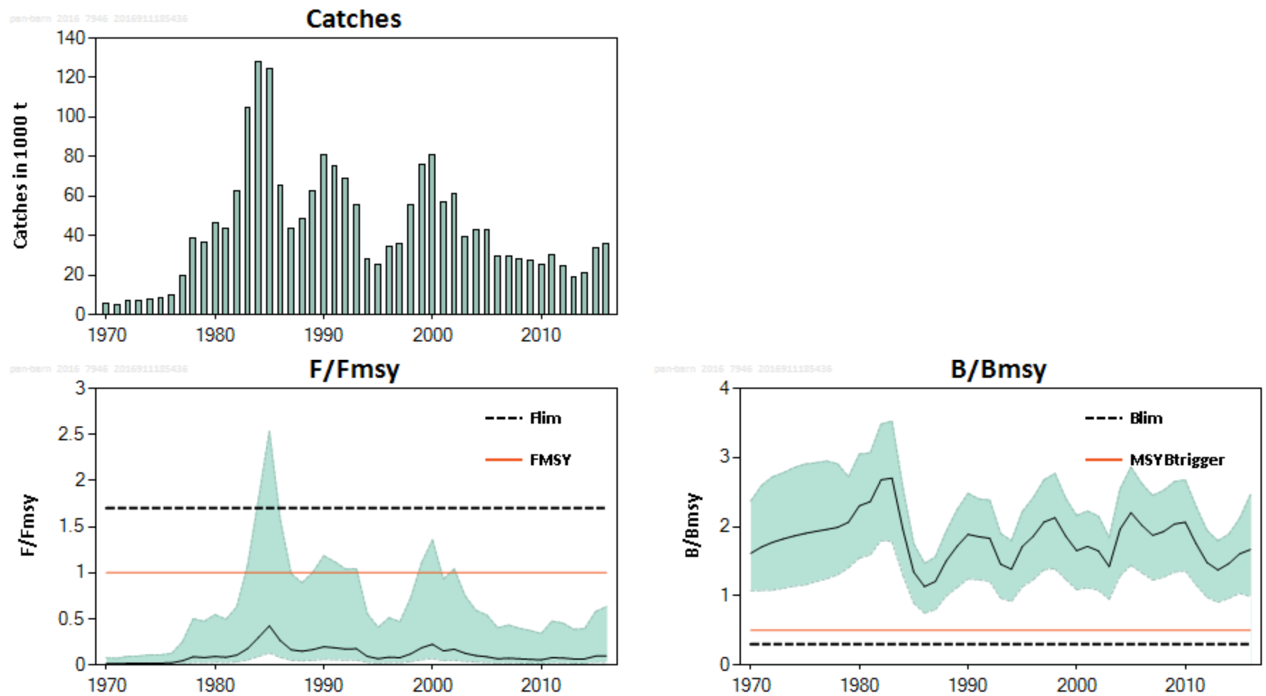

Figure 3.3.6.1 Northern shrimp in subareas 1 and 2. Summary of the stock assessment. Total catches, biomass, and fishing mortality relative to B_{MSY} and F_{MSY}, respectively, and with 90% probability intervals.

Stock and exploitation status

Table 3.3.6.1 Northern shrimp in subareas 1 and 2. State of the stock and fishery relative to reference points.

		Fishing pressure				Stock size				
		2013	2014	2015			2014	2015	2016	
Maximum sustainable yield	F_{MSY}	✓	✓	✓	Below	MSY $B_{trigger}$	✓	✓	✓	Above
Precautionary approach	F_{lim}	✓	✓	✓	Harvested sustainably	B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-	-	-	Not applicable

Catch options

Table 3.3.6.2 Northern shrimp in subareas 1 and 2. The basis for the catch options.

Variable	Value	Source	Notes
Median F_{2016}/F_{MSY}	0.10	ICES (2016a)	Corresponds to the estimated catch in 2016
Median B_{2017}/B_{MSY}	1.67	ICES (2016a)	Projection to the beginning of 2017, considering the estimated catch in 2016
Catch (2016)	36000 t	ICES (2016a)	Catch data until August and Information from the industry
Landings (2016)	36000 t	ICES (2016a)	All catches are assumed to be landed

Table 3.3.6.3 Northern shrimp in subareas 1 and 2. Catch options.

Catch options in 2017 (in thousand tonnes)	60	70	80	90	100	120	315
Stock size (B_{2018}/B_{MSY}), median	1.69	1.69	1.68	1.67	1.66	1.63	1.48
Fishing mortality (F_{2017}/F_{MSY}), median	0.16	0.19	0.22	0.25	0.27	0.33	1.00
Probability of B_{2018} falling below B_{lim}	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	1%

The stock is well above MSY $B_{trigger}$ and has always been exploited below F_{MSY}. Catches following the ICES MSY approach (fishing mortality at median F_{MSY}, which would imply catches of no more than 315 000 tonnes in 2017) would constitute a very large extrapolation beyond catches observed in the past. The assessment model may not be robust to forecast stock dynamics outside of the range of observed values.

An increase in annual catch to 70 000 tonnes would move stock exploitation in the direction of F_{MSY}. This corresponds to a two-fold increase with respect to recent exploitation (fishing mortality), and would provide information of the stock dynamics at an exploitation level not observed since the mid-1980s.

Basis of the advice

Table 3.3.6.4 Northern shrimp in subareas 1 and 2. The basis of the advice.

Advice basis	MSY approach combined with additional precautionary considerations.
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. The model was able to produce good simulations of the observed data. The results of this assessment are consistent with those of previous years.

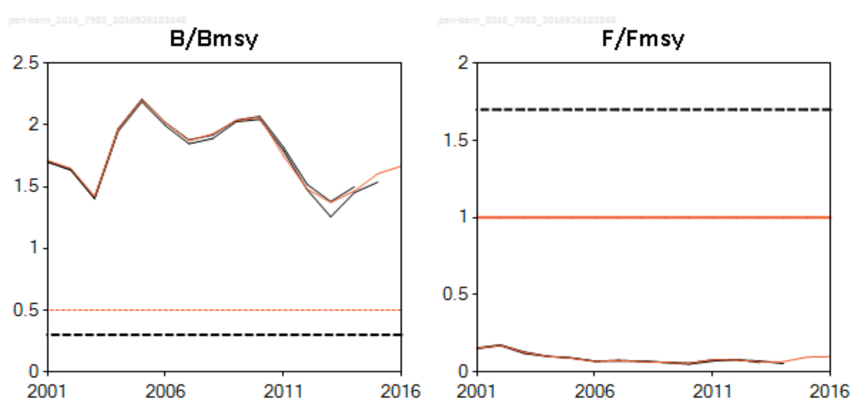

Figure 3.3.6.2 Northern shrimp in subareas 1 and 2. Historical assessment results.

Issues relevant for the advice

Assuming a catch of 36 kt for 2016, catch options up to 90 kt for 2017 have low probability of exceeding F_{lim} (< 5%) or of the SSB going below B_{lim} (< 1%) by the end of 2017 (Table 6.4 in ICES, 2016a); all of these options are likely to maintain the stock at its current high level.

Reference points

Table 3.3.6.5 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 × B_{MSY} = 0.25 × *K* *	Relative value. B_{MSY} is estimated directly from the assessment model and changes when the assessment is updated.	ICES (2013)
	F_{MSY}	1 = *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 × B_{MSY}	Relative value (equilibrium yield at this biomass is 50% of MSY).	ICES (2013)
	B_{pa}	Not defined	**	
	F_{lim}	1.7	Relative value (the F that drives the stock to B_{lim}).	ICES (2013)
	F_{pa}	Not defined	**	
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

* Fishing mortality is estimated in relation to F_{MSY} and total stock biomass is estimated in relation to B_{MSY}.
** B_{pa} and F_{pa} are not needed. As the assessment provides probability distributions for B and F, it is possible to estimate directly the probabilities of B < B_{lim} and of F > F_{lim}.

Basis of the assessment

Table 3.3.6.6 Northern shrimp in subareas 1 and 2. The basis of the assessment.

ICES stock data category	1 (ICES, 2016b).
Assessment type	Bayesian fitting of a surplus-production model that uses catches in the model and in the forecast.
Input data	Fishery catches 1970–2015. Three survey indices: the Norwegian shrimp survey 1982–2004, the Russian shrimp survey 1984–2005, and the Norwegian–Russian ecosystem survey (Eco-Norw-Q3) 2004–2015; one fishery-based index (standardized catch-per-unit-effort from Norwegian logbooks 1980–2015).
Discards and bycatch	Discarding is considered to be negligible.
Indicators	Length frequencies from survey catches and recruitment index from Norwegian and Russian surveys.
Other information	None.
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 3.3.6.7 Northern shrimp in subareas 1 and 2. History of ICES advice, the agreed TAC, and ICES estimates of landings (weights in thousand tonnes).

Year	ICES advice / Single-stock exploitation boundaries	Predicted catches corresp. to single-stock exploitation boundaries	Agreed TAC	ICES landings
2005	No increase compared to 2004	43.6	-	42.6
2006	No increase in catch above recent level	40	-	29.6
2007	Catch that will prevent exceeding F_{lim} in the long term	50	-	29.9
2008	Catch that will prevent exceeding F_{lim} in the long term	50	-	28.2
2009	Catch that will prevent exceeding F_{lim} in the long term	50	-	27.3
2010	Catch that will prevent exceeding F_{lim} in the long term	50	-	25.2
2011	Catch that will prevent exceeding F_{MSY} in the long term	60	-	30.2
2012	Catch that will prevent exceeding F_{MSY} in the long term	60	-	24.8
2013	Catch that will maintain stock at current high biomass	60	-	19.2
2014	No new advice, same as for 2013	60	-	21.0
2015	Move exploitation towards F_{MSY}	< 70	-	33.6
2016	Move exploitation towards F_{MSY}	< 70	-	
2017	Move exploitation towards F_{MSY}	≤ 70		

History of catch and landings

Table 3.3.6.8 Northern shrimp in subareas 1 and 2. Catch distribution by fleet in 2015 as estimated by ICES.

Total catch (2015)	Landings	Discards
33 624 t	100% trawl	0 t
	33 624 t	

Table 3.3.6.9 Northern shrimp in subareas 1 and 2. ICES catches (thousand tonnes). "Others" are the following EU countries: Portugal, Spain, UK, Lithuania, Estonia, Iceland, Faroes, and Greenland.

Year	Norway	Russia	Others	Total
1970	5.508	0	0	5.508
1971	5.116	0	0.026	5.142
1972	6.772	0	0	6.772
1973	6.921	0	0	6.921
1974	8.008	0	0	8.008
1975	8.197	0	0.002	8.199
1976	9.752	0	0	9.752
1977	14.700	0	4.854	19.554
1978	20.484	18.27	0.189	38.943
1979	25.435	10.474	0.39	36.299
1980	35.061	11.219	0	46.280
1981	32.713	9.886	1.011	43.610
1982	43.451	15.552	3.835	62.838
1983	70.798	29.105	4.903	104.806
1984	76.636	43.180	8.246	128.062
1985	82.123	32.104	10.262	124.489
1986	48.569	10.216	6.538	65.323
1987	31.353	6.690	5.324	43.367
1988	32.021	12.32	4.348	48.689
1989	47.064	12.252	3.432	62.748
1990	54.182	20.295	6.687	81.164
1991	39.663	29.434	6.156	75.253
1992	39.657	20.944	8.021	68.622
1993	32.663	22.397	0.806	55.866
1994	20.162	7.108	1.063	28.333
1995	19.337	3.564	2.319	25.220
1996	25.445	5.747	3.320	34.512
1997	29.079	1.493	5.163	35.735
1998	44.792	4.895	6.103	55.790
1999	52.612	10.765	12.293	75.670
2000	55.333	19.596	5.768	80.697
2001	43.031	5.846	8.408	57.285
2002	48.799	3.790	8.899	61.488
2003	34.172	2.776	2.277	39.225
2004	35.918	2.410	4.406	42.734
2005	37.253	0.435	4.930	42.618
2006	27.352	0.004	2.271	29.627
2007	25.558	0.192	4.181	29.931
2008	20.662	0.417	7.109	28.188
2009	19.784	0.000	7.488	27.272
2010	16.779	0.000	8.419	25.198
2011	19.928	0.000	10.298	30.226
2012	14.158	0.000	10.598	24.756
2013	8.846	1.067	9.336	19.249
2014	10.234	0.741	9.989	20.964
2015	16.839	1.151	15.634	33.624

Summary of the assessment

Table 3.3.6.10 Northern shrimp in subareas 1 and 2. Assessment summary (weights in tonnes). Biomass is relative to B_{MSY} and fishing mortality relative to F_{MSY}. High and low values are the 90% probability intervals of the distribution.

Year	B/B_{MSY}	High	Low	Total catch (tonnes)	F/F_{MSY}	High	Low
1970	1.615	2.368	1.077	5508	0.016	0.077	0.005
1971	1.706	2.596	1.082	5142	0.014	0.072	0.004
1972	1.772	2.720	1.109	6772	0.018	0.095	0.005
1973	1.823	2.778	1.140	6921	0.018	0.096	0.005
1974	1.865	2.854	1.159	8008	0.020	0.110	0.006
1975	1.902	2.904	1.205	8199	0.020	0.110	0.006
1976	1.932	2.923	1.247	9752	0.023	0.126	0.007
1977	1.959	2.948	1.304	19554	0.046	0.250	0.014
1978	1.990	2.908	1.406	38943	0.089	0.501	0.027
1979	2.064	2.719	1.548	36299	0.080	0.472	0.025
1980	2.301	3.049	1.591	46280	0.092	0.546	0.029
1981	2.361	3.066	1.800	43610	0.084	0.495	0.027
1982	2.677	3.483	1.786	62838	0.107	0.631	0.034
1983	2.701	3.523	1.303	104806	0.178	1.079	0.055
1984	1.964	2.566	0.895	128062	0.299	1.795	0.093
1985	1.343	1.755	0.752	124489	0.424	2.532	0.131
1986	1.134	1.469	0.800	65323	0.265	1.573	0.083
1987	1.208	1.562	0.999	43367	0.165	0.990	0.051
1988	1.505	1.935	1.121	48689	0.149	0.891	0.046
1989	1.718	2.245	1.246	62748	0.167	1.005	0.052
1990	1.888	2.482	1.231	81164	0.198	1.184	0.060
1991	1.854	2.400	1.211	75253	0.187	1.120	0.058
1992	1.831	2.384	0.967	68622	0.173	1.040	0.053
1993	1.458	1.901	0.920	55866	0.176	1.044	0.054
1994	1.384	1.796	1.131	28333	0.094	0.557	0.029
1995	1.712	2.218	1.231	25220	0.068	0.408	0.021
1996	1.859	2.418	1.380	34512	0.085	0.512	0.026
1997	2.068	2.677	1.392	35735	0.079	0.468	0.025
1998	2.129	2.769	1.240	55790	0.121	0.728	0.037
1999	1.861	2.408	1.089	75670	0.187	1.108	0.057
2000	1.652	2.160	1.117	80697	0.224	1.355	0.070
2001	1.715	2.225	1.082	57285	0.153	0.931	0.047
2002	1.649	2.153	0.949	61488	0.171	1.040	0.053
2003	1.422	1.842	1.290	39225	0.127	0.750	0.039
2004	1.963	2.546	1.442	42734	0.101	0.592	0.031
2005	2.202	2.861	1.333	42618	0.089	0.541	0.027
2006	2.020	2.621	1.228	29627	0.067	0.403	0.021
2007	1.874	2.451	1.270	29931	0.074	0.433	0.023
2008	1.928	2.523	1.342	28188	0.067	0.398	0.021
2009	2.038	2.652	1.363	27272	0.061	0.372	0.019
2010	2.064	2.674	1.159	25198	0.056	0.341	0.017
2011	1.752	2.289	0.979	30226	0.079	0.476	0.025
2012	1.482	1.947	0.907	24756	0.076	0.454	0.024
2013	1.373	1.795	0.963	19249	0.065	0.385	0.020
2014	1.465	1.891	1.037	20964	0.066	0.395	0.020
2015	1.607	2.117	0.990	33624	0.096	0.579	0.029
2016*	1.668	2.463	1.077	36000	0.099	0.632	0.028

* The 2016 data is a projection, assuming a catch of 36 000 t.

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