3.3.9 Northern shrimp (*Pandalus borealis*) in Subareas I and II (Northeast Arctic)

ICES stock advice

ICES advises that when the MSY approach is applied and combined with additional precautionary considerations, catches in 2016 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}.

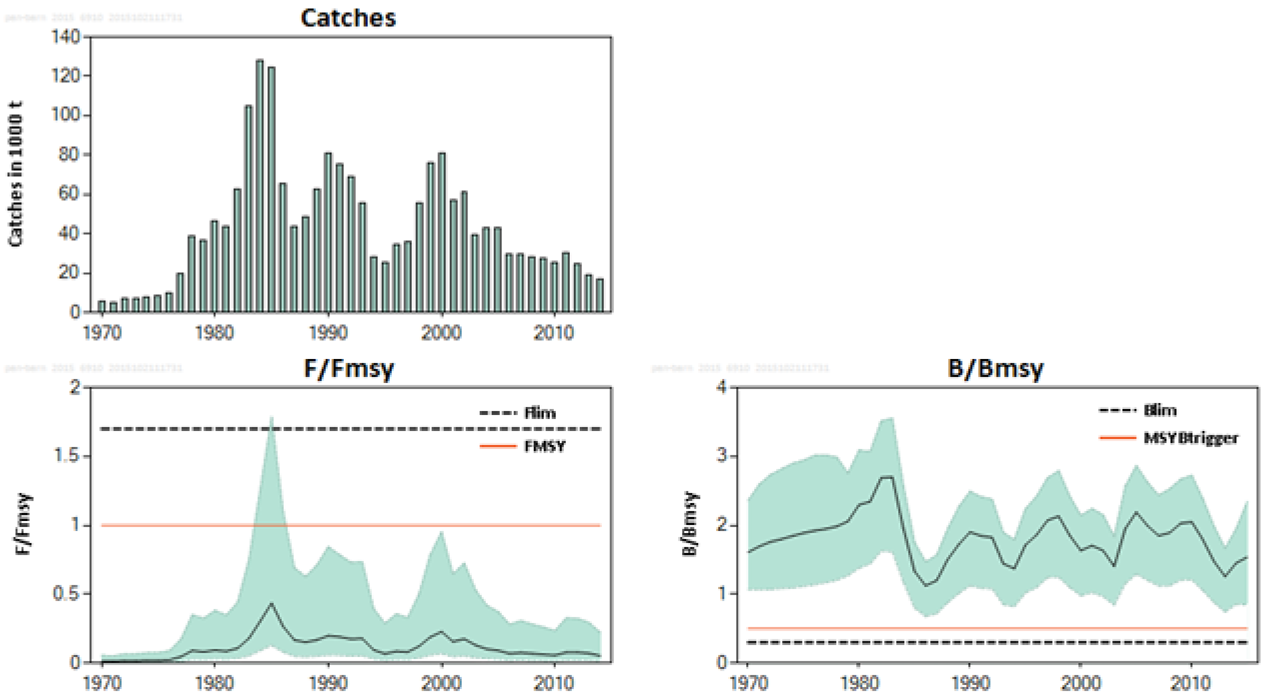

Figure 3.3.9.1 Northern shrimp in Subareas I and II. Summary of stock assessment. Total catches, biomass, and fishing mortality relative to B_{MSY} and F_{MSY}, respectively, and with 90% probability intervals.

Stock and exploitation status

Table 3.3.9.1 Northern shrimp in Subareas I and II. 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}	✓	✓	✓	Below	MSY $B_{trigger}$	✓	✓	✓	Above trigger
Precautionary approach	F_{lim}	✓	✓	✓	Harvested sustainably	B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-	-	-	Not applicable

Catch options

Table 3.3.9.2 Northern shrimp in Subareas I and II. The basis for the catch options.

Variable	Value	Source	Notes
Median F_{2015}/F_{MSY}	0.06	ICES (2015a)	Corresponds to the assumed catch in 2015
Median B_{2016}/B_{MSY}	1.54	ICES (2015a)	Projection to the beginning of 2016, considering the assumed catch in 2015
Catch (2015)	20000 t	ICES (2015a)	Catch data until August and Information from the industry
Landings (2015)	20000 t	ICES (2015a)	All catches are assumed to be landed
Discards (2015)	0 t	ICES (2015a)	All catches are assumed to be landed

Table 3.3.9.3 Northern shrimp in Subareas I and II. Catch options.

Catch option 2016 (in thousand tonnes)	50	60	70	80	90	100	290
Stock size (B_{2017}/B_{MSY}), median	1.59	1.58	1.57	1.57	1.56	1.55	1.37
Fishing mortality (F_{2016}/F_{MSY}), median	0.15	0.18	0.21	0.23	0.27	0.30	1
Probability of B_{2017} falling below B_{lim}	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	1%

The stock is well above MSY $B_{trigger}$ and has always been exploited far below F_{MSY}. Catches following the ICES MSY approach (fishing mortality at F_{MSY}, which would imply catches of no more than 290 000 tonnes in 2016) would constitute a very large extrapolation from the regions covered by past data on catches. This would bring the stock in a region not seen in the history of the fishery, and the assessment model may not be robust to forecast stock dynamics under such circumstances.

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

Basis of the advice

Table 3.3.9.4 Northern shrimp in Subareas I and II. 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.

The survey coverage for 2014 was incomplete due to non-conductive conditions related to ice, resulting in no coverage for one of the northern stratums (stratum 3). The 2014 survey estimate was, however, used in this assessment but was recalculated based on average ratio of survey estimates that assumes complete coverage to survey estimates assuming missing coverage for the years 2009—2013. While this is a source of uncertainty in the assessment it should be noted that survey data from the missing stratum have only constituted about 10% of the biomass in the past years, which is considered to be of no consequence to the assessment results.

Figure 3.3.9.2 Northern shrimp in Subareas I and II. Historical assessment results.

Issues relevant for the advice

There is no information to present for this stock.

Reference points

Table 3.3.9.5 Northern shrimp in Subareas I and II. 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 directly estimated from the assessment model and changes when the assessment is updated.	ICES (2013)
	F_{MSY}	1 = *r*/2 *	Relative value. F_{MSY} is directly estimated 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 F_{MSY}	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 only in relation to F_{MSY} and total stock biomass is estimated only in relation to B_{MSY}. *K* is the carrying capacity and *r* is the intrinsic biomass growth rate.
** 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 probability of B < B_{lim} and the probability of F > F_{lim}.

Basis of the assessment

Table 3.3.9.6 Northern shrimp in Subareas I and II. The basis of the assessment.

ICES stock data category	1 (ICES, 2015b).
Assessment type	Bayesian fitting of a surplus-production model that uses catches in the model and in the forecast.
Input data	Fishery catches. 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—2014; one fishery-based index (standardized catch-per-unit-effort from Norwegian logbooks since 1980).
Discards and bycatch	Not included, considered 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 advice, catch and management

Table 3.3.9.7 Northern shrimp in Subareas I and II. 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	-	16.7
2015	Move exploitation towards F_{MSY}	< 70	-	
2016	Move exploitation towards F_{MSY}	< 70		

History of catch and landings

Table 3.3.9.8 Northern shrimp in Subareas I and II. Catch distribution by fleet in 2014 as estimated by ICES.

Total catch (2014)	Landings	Discards
16.7 kt	100% trawl	0 kt
	16.7 kt	

Table 3.3.9.9 Northern shrimp in Subareas I and II. ICES catches (thousand tonnes). Others are 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	7.701	0.741	8.229	16.671

Summary of the assessment

Table 3.3.9.10 Northern shrimp in Subareas I and II. 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	1.609	2.361	1.067	5508	0.016	0.056	0.005
1971	1.694	2.592	1.062	5142	0.014	0.051	0.004
1972	1.759	2.731	1.069	6772	0.018	0.066	0.005
1973	1.799	2816	1.082	6921	0.018	0.066	0.005
1974	1.845	2.897	1.091	8008	0.02	0.075	0.006
1975	1.888	2.942	1.115	8199	0.02	0.076	0.006
1976	1.922	3.015	1.137	9752	0.024	0.089	0.007
1977	1.947	3.018	1.168	19554	0.046	0.173	0.014
1978	1.985	2.988	1.203	38943	0.09	0.35	0.027
1979	2.058	2.754	1.269	36299	0.082	0.325	0.025
1980	2.297	3.089	1.381	46280	0.094	0.381	0.028
1981	2.344	3.068	1.440	43610	0.086	0.349	0.026
1982	2.688	3.512	1.627	62838	0.108	0.441	0.033
1983	2.700	3.553	1.615	104806	0.18	0.749	0.053
1984	1.951	2.570	1.174	128062	0.305	1.26	0.091
1985	1.332	1.752	0.801	124489	0.435	1.784	0.13
1986	1.124	1.469	0.678	65323	0.268	1.109	0.081
1987	1.199	1.567	0.717	43367	0.168	0.692	0.05
1988	1.506	1.953	0.880	48689	0.151	0.628	0.045
1989	1.724	2.269	1.013	62748	0.169	0.712	0.05
1990	1.901	2.491	1.124	81164	0.199	0.844	0.058
1991	1.846	2.413	1.086	75253	0.191	0.785	0.057
1992	1.823	2.378	1.080	68622	0.175	0.73	0.052
1993	1.444	1.896	0.850	55866	0.179	0.735	0.054
1994	1.371	1.790	0.819	28333	0.096	0.395	0.029
1995	1.715	2.239	1.020	25220	0.068	0.289	0.02
1996	1.860	2.420	1.097	34512	0.086	0.357	0.026
1997	2.072	2.689	1.243	35735	0.081	0.329	0.024
1998	2.131	2.791	1.248	55790	0.122	0.499	0.036
1999	1.851	2.421	1.098	75670	0.189	0.786	0.057
2000	1.633	2.141	0.978	80697	0.228	0.951	0.069
2001	1.705	2.241	1.023	57285	0.156	0.646	0.047
2002	1.634	2.153	0.968	61488	0.176	0.725	0.052
2003	1.403	1.837	0.842	39225	0.13	0.53	0.039
2004	1.950	2.565	1.152	42734	0.102	0.418	0.03
2005	2.189	2.865	1.292	42618	0.092	0.372	0.027
2006	1.995	2.626	1.204	29627	0.069	0.281	0.021
2007	1.849	2.436	1.120	29931	0.075	0.307	0.023
2008	1.891	2.527	1.123	28188	0.069	0.282	0.021
2009	2.028	2.668	1.204	27272	0.062	0.261	0.019
2010	2.047	2.725	1.209	25198	0.057	0.235	0.017
2011	1.793	2.382	1.055	30226	0.078	0.328	0.023
2012	1.477	1.987	0.880	24756	0.078	0.323	0.023
2013	1.257	1.666	0.743	19249	0.071	0.295	0.021
2014	1.453	1.949	0.854	16671	0.053	0.223	0.015
2015	1.538	2.342	0.846				
Average	**1.809**	**2.469**	**1.081**	**43703**	**0.115**	**0.475**	**0.034**

Sources and references

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