IMR/PINRO
14
2024
Joint Report Series

JOINT



REPORT

Advice on fishing opportunities for northern shrimp (*Pandalus borealis*) in the Barents Sea (ICES subareas 1 and 2)

Institute of Marine Research – IMR

Polar branch of the FSBSI “VINRO” (“PINRO”)

Title (English and Norwegian):

Advice on fishing opportunities for northern shrimp (*Pandalus borealis*) in the Barents Sea (ICES subareas 1 and 2)

Report series:	Year - No.:	Date:
IMR-PINRO	2024-14	14.11.2024

Distribution:
Open

Program:
Barentshavet og Polhavet

Research group(s):
Bentiske ressurser og prosesser

Number of pages:
11

Content

Advice on fishing opportunities 4
Stock development over time 4
Catch scenarios 4
Basis of the advice 5
Quality of assessment 5
Issues relevant for the advice 5
Reference points 6
Basis of the assessment 6
History of the advice, catch, and management 7
History of the catch and landings 7
Summary of the assessment 9
Sources and references 10

Advice on fishing opportunities

The Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG) advises that when the MSY approach is applied, catches of northern shrimp in the Barents Sea in 2025 should not exceed 150 000 tonnes.

Stock development over time

Exploitable stock biomass has remained above MSY $B_{trigger}$ and B_{lim} throughout the entire time series. Fishing pressure on the stock has been estimated below F_{MSY} and F_{lim}, with a low probability of exceeding F_{MSY} in 2024.

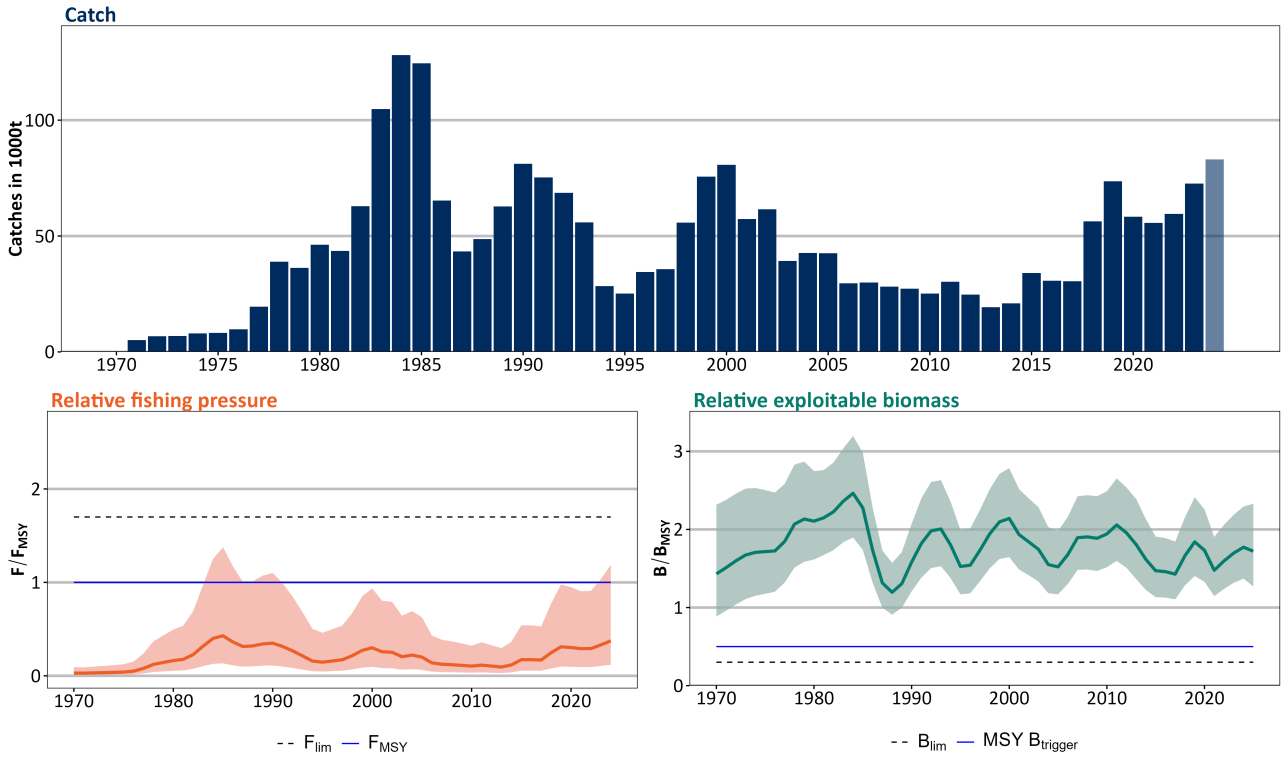


Figure 1: Stock assessment summary of northern shrimp in ICES subareas 1 and 2. Top: total catches (the final, lighter coloured bar depicts preliminary estimation of 2024 catches). Bottom: fishing mortality (orange) and exploited biomass (green) at the beginning of the year, relative to F_{MSY} and B_{MSY}, respectively, with orange and green lines showing estimated means and shaded areas 95% confidence intervals. Blue and dashed horizontal lines, respectively, indicate the MSY and precautionary approach reference points.

Catch scenarios

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

Variable	Value	Notes
F_{2024}/F_{MSY}	0.39	Corresponds to the predicted catch in 2024
B_{2025}/B_{MSY}	1.72	Short-term forecast (STF)
Catch 2024	83	Based on preliminary catch data (Norway and Russia) + average catches from other fleets in 2021-2023

Table 2: Northern shrimp in ICES subareas 1 and 2. Annual catch scenarios for 2025. Catches are in thousand tonnes, exploitable biomass and fishing mortality are relative values, and risks are in percentages.

Scenario	Catch	B_{2026}/B_{MSY}	F_{2025}/F_{MSY}	% risk of B_{2026} < MSY $B_{trigger}$	% risk of F_{2025} > F_{MSY}	% risk of F_{2025} > F_{lim}
MSY approach*	150	1.60	0.72	<0.1	30	8.6
$F_{2025} = F_{MSY}$	203	1.53	1.00	<0.1	50	20
$F_{2025} = F_{2024}$	82	1.69	0.38	<0.1	6.4	0.89
$F_{2025} = 0$	0	1.81	0.00	<0.1	<0.1	<0.1
*Using the fractile rule with 35th percentiles of F/F_{MSY} and B/B_{MSY} distributions and the catch distribution under $F=F_{MSY}$						

Basis of the advice

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

Advice basis	Precautionary MSY approach using 35th percentiles of fishing mortality, exploitable biomass and catch.
Management plan	No agreed precautionary management plan for northern shrimp in this area.

Quality of assessment

In the 2024 assessment, the issue of negligible weight of the survey indices (ICES, 2022) on the stock estimates was addressed by incorporating the estimated uncertainty of the stock indices as observation error priors. This caused the stock trends to follow the survey indices more closely, resulting in shifted and slightly less pronounced fluctuations compared to previous assessments (Figure 2). However, compared to previous assessments the change did not affect the perception of the state of the stock or catch advice. The strong dependency on the commercial CPUE index was considered a major remaining issue after the benchmark. This year's revised assessment is therefore considered an improvement that likely reflects the development of the stock better by linking it more closely to the ecosystem survey in the Barents Sea that covers the entire stock area.

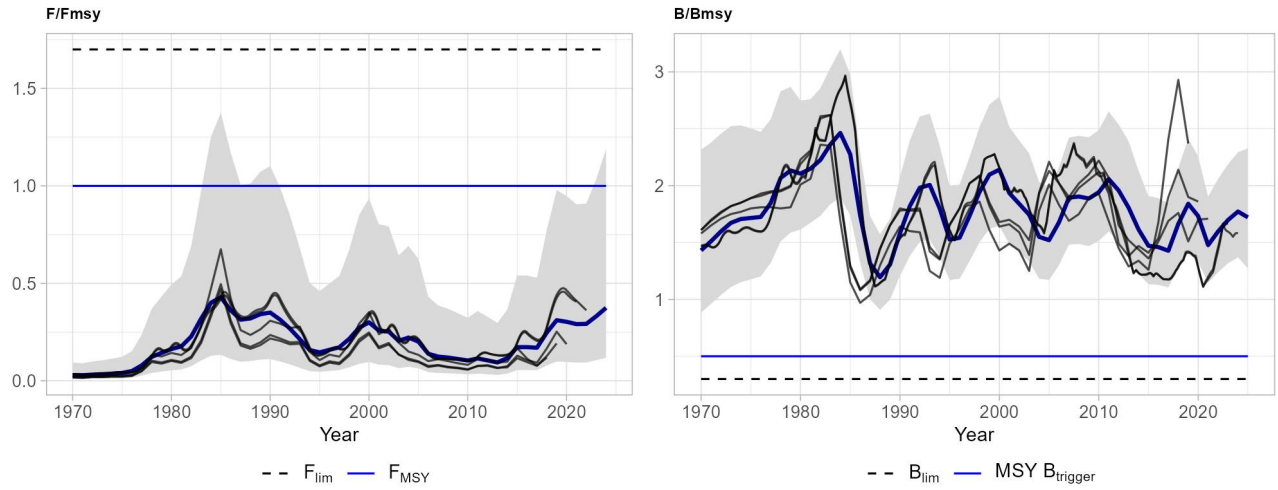


Figure 2: Historical assessment results for northern shrimp in ICES subareas 1 and 2. Trends of F/F_{MSY} and B/B_{MSY} as estimated in the past stock assessments in 2019 to 2023 (black lines show estimated mean) are compared with the current assessment (blue lines and shaded areas show estimated mean and 95% confidence intervals, respectively).

Issues relevant for the advice

A precautionary MSY approach recommended by ICES (Berg *et al.*, 2021) for SPiCT assessments (Pedersen and Berg, 2017) was applied to account for the uncertainty in estimates. Fishing mortality at median F_{MSY} would

imply a catch advice of 203 000 t in 2025, far above historic catches. Considering that MSY is much higher than observed catches, it is very uncertain how the stock would respond to such an increase in catches. This was addressed previously by using the mode of F_{MSY} distribution instead of the mean, resulting in a similarly precautionary reduction of catch advice as the precautionary MSY approach implemented this year. Harvest control rules were recommended for the stock in 2024 and could replace the current MSY approach if adopted as the management plan (Trochta et al., 2024).

Conflicting trends between the survey and commercial CPUE indices for part of the time series may indicate that the standardization of the commercial CPUE index does not account sufficiently well for the spatial contraction of the fishery over the past two decades. Further investigations should also include the potential utility of the demersal fish survey in winter as an information source.

Sensitivity analysis showed that the priors have little impact on the perception of stock state and advice. However, the current configuration with informative priors results in some sensitivity to the underlying assumptions, especially on carrying capacity. The validity of these assumptions should be re-evaluated regularly. More contrast in the input time series might help to decrease the dependency on priors in the future.

Surplus production models assess only the exploitable biomass and therefore lack information on recruitment and other drivers of stock fluctuations. Information on size composition of the stock could provide an auxiliary indicator of the state of the stock.

Reference points

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

Framework	Reference points	Value*	Technical basis
MSY approach	MSY $B_{trigger}$	B/B_{MSY} = 0.5	Relative value from the SPiCT model. Reference points are estimated directly from the SPiCT assessment model and change when the assessment is updated.
	F_{MSY}	F/F_{MSY} = 1	
Precautionary approach	B_{lim}	B/B_{MSY} = 0.3	
	F_{lim}	F/F_{MSY} = 1.7	

*No reference points are defined for this stock in terms of absolute values. The SPiCT-estimated values of the ratios F/F_{MSY} and B/B_{MSY} are used to estimate stock status relative to the MSY reference points.

Basis of the assessment

Table 5: Northern shrimp in ICES subareas 1 and 2. The basis of the advice.

Assessment type	Surplus production in continuous time (SPiCT)
Input data	Fishery catches (1970—2024). Two survey indices: the combined Norwegian and Russian shrimp surveys (1984—2002) and the Norwegian/Russian ecosystem survey (2004—2024); one fishery-based index (standardized CPUE from Norwegian logbooks) (1980—2024).
Discards and bycatch	Discarding is considered to be negligible.
Indicators	Standardized CPUE index from the Russian fleet.
Other information	None
Working group	Joint Russian-Norwegian Artic Fisheries Working Group

History of the advice, catch, and management

Table 6: Northern shrimp in ICES subareas 1 and 2. ICES advice and official landings. All weights are in tonnes. Assessment and advice were carried out by the NAFO-ICES Pandalus Assessmen Group (NIPAG) until 2021, by the Joint Russian-Norwegian shrimp working group in 2022 and 2023, and by Joint Russian-Norwegian working group on Arctic Fisheries (JNR-AFWG) in 2024.

Year	Advice	Catch corresponding to advice	Agreed TAC	Total catch
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	Move exploitation towards F_{MSY}	≤ 70000	-	56341
2019	Move exploitation towards F_{MSY}	≤ 70000	-	73582
2020	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 150000	-	58380
2021	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 140000	-	55642
2022	MSY approach: mode of the F_{MSY} distribution as basis of advice	≤ 140000	-	59580
2023	MSY approach: mode of the F_{MSY} distribution as basis of advice*	≤156000	-	72647
2024	MSY approach: mode of the F_{MSY} distribution as basis of advice*	≤143000	-	
2025	MSY approach: 35th fracticles of B/B_{MSY}, F/F_{MSY} and catch distributions as basis of advice**	≤150000		

*In 2022-2023 assessment and advice were provided by the Joint Russian-Norwegian working group on shrimp.

**In 2024 assessment and advice were provided by the Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG).

History of the catch and landings

Table 7: Total catches of northern shrimp in ICES subareas 1 and 2 by country. Catches for the final year are based on preliminary information. Country-specific information only available from 2006 (except for Norway and Russia). All values are in tonnes.

Year	Norway	Russia	EU	Greenland	Faroes	Iceland	United Kingdom	Others/unknown
1970	5508							0
1971	5116							26
1972	6772							0
1973	6921							0
1974	8008							0
1975	8197							2
1976	9752							0
1977	14700							4854

Year	Norway	Russia	EU	Greenland	Faroes	Iceland	United Kingdom	Others/unknown
1978	20484	18270						189
1979	25435	10474						390
1980	35061	11219						0
1981	32713	9886						1011
1982	43451	15552						3835
1983	70798	29105						4903
1984	76636	43180						8246
1985	82123	32104						10262
1986	48569	10216						6538
1987	31353	6690						5324
1988	32021	12320						4348
1989	47064	12252						3432
1990	54182	20295						6687
1991	39663	29434						6156
1992	39657	20944						8021
1993	32663	22397						806
1994	20162	7108						1063
1995	19337	3564						2319
1996	25445	5747						3320
1997	29079	1493						5163
1998	44792	4895						6103
1999	52612	10765						12293
2000	55333	19596						5768
2001	43031	5846	0	0	0	0	0	8408
2002	48799	3790	0	0	0	0	0	8899
2003	34172	2776	0	0	0	0	0	2277
2004	35918	2410	0	0	0	0	0	4406
2005	37253	435	0	0	0	0	0	4930
2006	27352	4	1365	0	906	0	0	
2007	25558	192	1729	0	2451	0	0	
2008	20662	417	2207	0	4902	0	0	
2009	19784	0	4903	0	2586	0	0	
2010	16776	0	6309	0	2110	0	0	
2011	19928	0	5292	0	4432	574	0	
2012	14159	5	5073	0	4205	41	1280	
2013	8846	1067	5416	95	3660	164	0	
2014	10234	741	5667	149	4171	2	0	
2015	16618	1151	8665	2774	4665	148	0	
2016	10898	2491	9275	2821	4920	344	0	
2017	7010	3849	11406	3487	4689	0	0	

Year	Norway	Russia	EU	Greenland	Faroes	Iceland	United Kingdom	Others/unknown
2018	23126	12561	13394	803	5173	0	1283	
2019	23925	28081	15342	1566	4325	0	344	
2020	19116	21265	14489	633	2750	0	128	
2021	30177	12379	10638	0	2311	0	136	
2022	35290	3809	17662	0	2819	0	0	
2023	34764	12288	23179	0	2416	0	0	

Summary of the assessment

Table 8: Northern shrimp in ICES subareas 1 and 2. Estimated exploitable biomass, catch and fishing mortality over time. Exploitable biomass and fishing mortality are relativ to B_{MSY} and F_{MSY}, with 95% confidence intervals (low and high values). Predicted catches are mean estimates of catches in the stock assessment model. Catches for the final year are based on preliminary information.

	Relative exploitable biomass					Relative fishing pressure		
Year	B/B_{MSY} (low)	B/B_{MSY}	B/B_{MSY} (high)	Catch	Predicted catch	F/F_{MSY} (low)	F/F_{MSY}	F/F_{MSY} (high)
1970	0.88	1.43	2.32	6	5	0.01	0.03	0.09
1971	0.96	1.51	2.38	5	6	0.01	0.03	0.09
1972	1.04	1.60	2.46	7	6	0.01	0.03	0.10
1973	1.11	1.67	2.52	7	7	0.01	0.03	0.11
1974	1.15	1.71	2.53	8	8	0.01	0.04	0.11
1975	1.18	1.72	2.50	8	9	0.01	0.04	0.12
1976	1.20	1.72	2.47	10	11	0.02	0.05	0.15
1977	1.32	1.85	2.58	20	19	0.03	0.08	0.24
1978	1.51	2.07	2.83	39	33	0.04	0.12	0.37
1979	1.59	2.13	2.87	36	38	0.05	0.14	0.43
1980	1.61	2.11	2.75	46	43	0.05	0.16	0.49
1981	1.67	2.15	2.76	44	48	0.06	0.18	0.54
1982	1.73	2.23	2.86	63	65	0.07	0.23	0.69
1983	1.84	2.36	3.04	105	97	0.10	0.32	0.97
1984	1.90	2.46	3.20	128	121	0.13	0.40	1.25
1985	1.74	2.28	2.98	124	110	0.13	0.43	1.38
1986	1.32	1.74	2.28	65	69	0.11	0.36	1.17
1987	1.00	1.32	1.73	43	48	0.10	0.31	1.01
1988	0.91	1.20	1.57	49	49	0.10	0.32	1.01
1989	1.00	1.31	1.71	63	62	0.11	0.34	1.07
1990	1.21	1.58	2.07	81	74	0.11	0.35	1.10
1991	1.38	1.82	2.40	75	74	0.10	0.31	0.99
1992	1.51	1.98	2.61	69	67	0.08	0.27	0.85
1993	1.53	2.01	2.63	56	52	0.07	0.21	0.68
1994	1.38	1.80	2.35	28	33	0.05	0.16	0.50
1995	1.17	1.53	1.99	25	27	0.05	0.15	0.46
1996	1.18	1.54	2.01	35	33	0.05	0.16	0.50
1997	1.34	1.73	2.25	36	39	0.06	0.17	0.54
1998	1.50	1.94	2.52	56	55	0.07	0.22	0.67

	Relative exploitable biomass					Relative fishing pressure			
Year	B/B (low)	B/B	B/B (high)	Catch	Predicted catch	F/F (low)	F/F	F/F (high)	
1999	1.62	2.10	2.71	76	73	0.09	0.27	0.85	
2000	1.65	2.14	2.78	81	77	0.10	0.30	0.94	
2001	1.49	1.93	2.52	57	60	0.08	0.26	0.80	
2002	1.41	1.84	2.40	61	58	0.08	0.25	0.79	
2003	1.33	1.74	2.28	39	42	0.07	0.21	0.64	
2004	1.18	1.55	2.03	43	41	0.07	0.22	0.69	
2005	1.17	1.52	1.98	43	41	0.06	0.20	0.63	
2006	1.30	1.68	2.16	30	31	0.04	0.14	0.43	
2007	1.48	1.89	2.42	30	30	0.04	0.12	0.39	
2008	1.49	1.90	2.44	28	28	0.04	0.12	0.37	
2009	1.47	1.89	2.43	27	27	0.04	0.11	0.35	
2010	1.52	1.94	2.49	25	26	0.03	0.10	0.32	
2011	1.60	2.06	2.65	30	29	0.04	0.11	0.36	
2012	1.51	1.96	2.54	25	25	0.03	0.10	0.33	
2013	1.37	1.81	2.39	19	20	0.03	0.09	0.30	
2014	1.22	1.61	2.13	21	22	0.04	0.12	0.37	
2015	1.13	1.47	1.91	34	32	0.06	0.17	0.54	
2016	1.13	1.46	1.89	31	31	0.06	0.17	0.54	
2017	1.10	1.43	1.84	30	32	0.05	0.17	0.53	
2018	1.28	1.66	2.15	56	55	0.08	0.25	0.77	
2019	1.40	1.84	2.41	74	71	0.10	0.31	0.98	
2020	1.33	1.73	2.26	58	59	0.10	0.30	0.95	
2021	1.15	1.48	1.90	56	56	0.09	0.29	0.91	
2022	1.24	1.60	2.06	60	61	0.09	0.29	0.91	
2023	1.32	1.70	2.19	73	72	0.11	0.33	1.03	
2024	1.37	1.77	2.29	83	82	0.12	0.37	1.19	
2025	1.27	1.72	2.33						

Sources and references

Berg, C., Coleman, P., Cooper, A., Hansen, H. Ø., Haslob, H., Herrariz, I. G., Kokkalis, A., *et al.* 2021. Benchmark workshop on the development of MSY advice for category 3 stocks using surplus production model in continuous time; SPiCT (WKMSYSPiCT).

ICES. 2022. Benchmark workshop on pandalus stocks (WKPRAWN). Report. ICES Scientific Reports. https://ices-library.figshare.com/articles/report/Benchmark_workshop_on_Pandalus_stocks_WKPRAWN_/19714204.

Pedersen, M. W., and Berg, C. W. 2017. A stochastic surplus production model in continuous time. Fish and Fisheries, 18: 226–243. https://onlinelibrary.wiley.com/doi/abs/10.1111/faf.12174.

Trochta, J. T., Stekso, A., Olssøn, R., Danielsen, H. E., Jenssen, M., and Zimmermann, F. 2024. Management strategy evaluation for northern shrimp in the Barents Sea (ICES subareas 1 and 2). IMR-PINRO report series.



Institute of Marine Research – IMR

Polar branch of the FSBSI “VINRO” (“PINRO”)