

IMR/PINRO

3

2022

Joint Report Series

JOINT



Advice on fishing opportunities
for Northeast Arctic cod in 2023
in 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 Northeast Arctic cod in 2023 in ICES subareas 1 and 2

Report series:

IMR-PINRO

Year - No.:

2022-3

Date:

06.09.2022

Distribution:

Open

Author(s):

Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG)

Number of pages:

17

Approved by: Research Director(s): Geir Huse Program leader(s): Maria Fossheim External: Oleg Bulatov (VNIRO)

Content

Stock Name: Northeast Arctic cod (ICES subareas 1 and 2)	4
Advice on fishing opportunities	4
Stock development over time	4
Catch scenarios	5
Basis of the advice	6
Quality of the assessment	6
Issues relevant for the advice	7
Reference points	8
Basis of the assessment	9
History of the advice, catch, and management	9
History of catch and landings	12
Summary of the assessment	14
References	16

Stock Name: Northeast Arctic cod (ICES subareas 1 and 2)

Advice on fishing opportunities

The Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG) advises that when the Joint Norwegian-Russian Fisheries Commission management plan is applied, catches in 2023 should be no more than 566 784 tonnes.

Stock development over time

Fishing pressure on the stock is between F_{pa} and F_{lim} and within the F_{MGT} range and spawning-stock size is above B_{pa} and B_{lim} and between the lower and middle breakpoints (SSB_{MGT} values) in the harvest control rule.

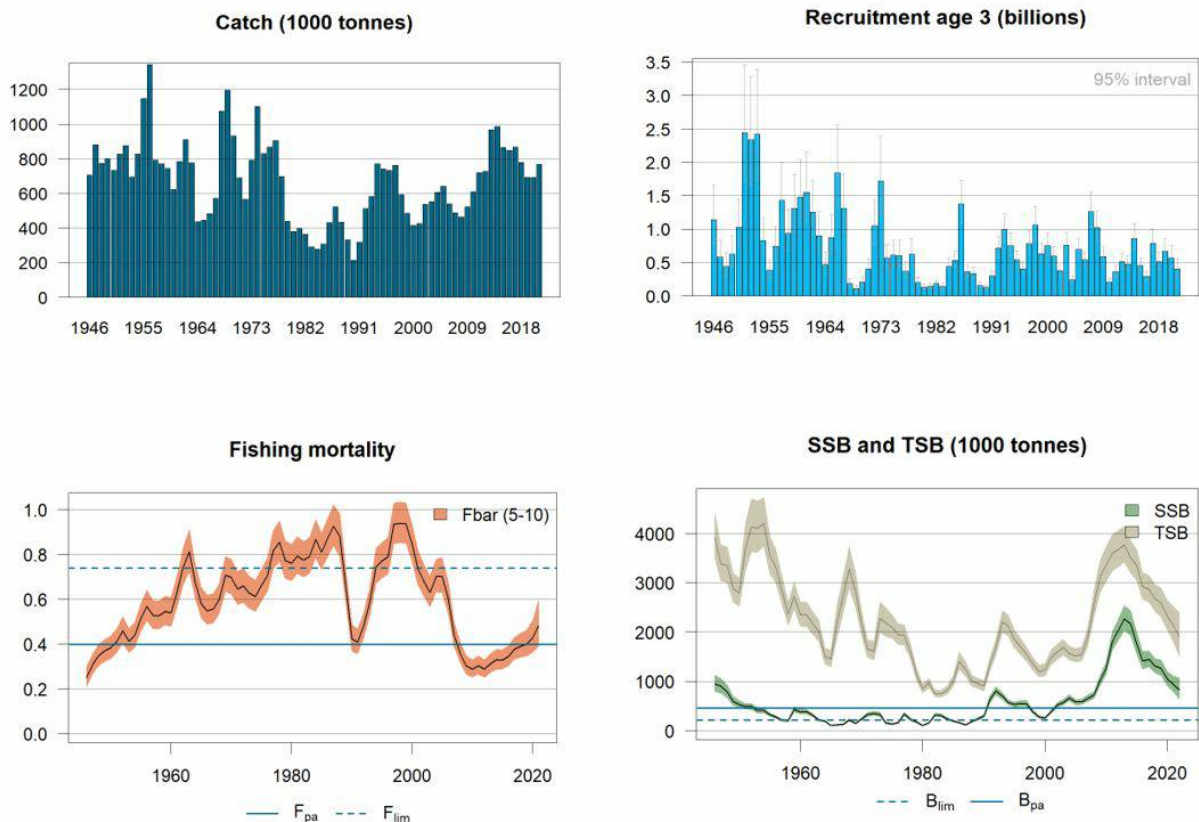


Figure 1 Cod in ICES subareas 1 and 2 (Northeast Arctic). Catch, recruitment, F , SSB and TSB (total stock biomass, age 3+) with 95 % confidence levels. The biomass reference points relate to SSB. For this stock, F_{MGT} ranges from 0.40 to 0.60, and there are three SSB MGT values (460 000, 920 000 and 1 380 000 tonnes).

Catch scenarios

Table 1 Cod in ICES subareas 1 and 2 (Northeast Arctic). Assumptions made for the interim year and in the forecast. SSB, catch in tonnes, and recruitment in thousands.

Variable	Value	Notes
F ages 5–10 (2022)	0.481	$F_{sq} = F_{2021}$. From assessment
SSB (2023)	751 297	From assessment
Rage 3 (2022)	476 000	From recruitment model
Rage 3 (2023)	566 000	From recruitment model
Rage 3 (2024)	383 000	From recruitment model
Total catch (2022)	640 700	Corresponding to F_{sq}

Table 2 Cod in ICES subareas 1 and 2 (Northeast Arctic). Annual catch options. All weights are in tonnes.

Basis	Total catch (2023)	Ftotal (2023)	SSB(2024)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan [^]	566 784	0.484	668 851	-11	-20	-20
Other options						
MSY approach: F_{MSY}	487 049	0.40	731 342	-3	-31	-31
F = 0	0	0	1 134 101	51	-100	-100
F = F ₂₀₂₁	564 475	0.481	670 645	-11	-20	-20
F = F _{pa}	487 049	0.40	731 342	-3	-31	-31
F = F _{lim}	775 883	0.74	510 976	-32	10	10

* SSB 2024 relative to SSB 2023.

** Advice value for 2023 relative to TAC for 2022 (708 480 tonnes).

*** Advice value for 2023 relative to advice for 2022.

[^] Since SSB in 2023 is between $B_{pa} = 460\,000$ tonnes and $2 \times B_{pa} = 920\,000$ tonnes, $F = 0.40$ is used in the 3-year prediction, giving catches of 487 049, 476 906 and 468 560 tonnes in 2023, 2024, and 2025, respectively. The average of this is 477 505 tonnes. According to the harvest control rule (HCR), the maximum decrease in TAC is limited by 20%, giving a catch of 566 784 tonnes, which corresponds to an F of 0.484 in 2023.

The advice for 2023 is 20 % lower than the advice for 2022 due to a declining stock trend and the application of the 20% TAC change constraint.

Basis of the advice

Table 3 Cod in ICES subareas 1 and 2 (Northeast Arctic). The basis of the advice.

Advice basis	Joint Norwegian-Russian Fisheries Commission management plan
Management plan	<p>At the 46th meeting of the Joint Norwegian-Russian Fisheries Commission (JNRFC) in October 2016, the previously used management plan was amended, and the current plan is as follows:</p> <p>The TAC is calculated as the average catch predicted for the coming 3 years, using the target level of exploitation (F_{tr}). The target level of exploitation is calculated according to the spawning-stock biomass (SSB) in the first year of the forecast as follows: - if $SSB < B_{pa}$, then $F_{tr} = SSB / B_{pa} \times F_{MSY}$; - if $B_{pa} \leq SSB \leq 2 \times B_{pa}$, then $F_{tr} = F_{MSY}$; - if $2 \times B_{pa} < SSB < 3 \times B_{pa}$, then $F_{tr} = F_{MSY} \times (1 + 0.5 \times (SSB - 2 \times B_{pa}) / B_{pa})$; - if $SSB \geq 3 \times B_{pa}$, then $F_{tr} = 1.5 \times F_{MSY}$; where $F_{MSY} = 0.40$ and $B_{pa} = 460\ 000$ tonnes.</p> <p>If the spawning-stock biomass in the present year, the previous year, and each of the three years of prediction is above B_{pa}, the TAC should not be changed by more than $\pm 20\%$ compared with the previous year's TAC. In this case, F_{tr} should however not be below 0.30.</p> <p>In 2014, JNRFC decided that from 2015 onwards, Norway and Russia can transfer to or borrow from the following year up to 10% of the country's quota. In 2021, this was increased to 15% as an extraordinary measure for transfers between 2021 and 2022 only.</p> <p>ICES evaluated this harvest control rule in 2016 (ICES, 2016) and 2021 (ICES, 2021) and concluded that it is precautionary.</p>

Quality of the assessment

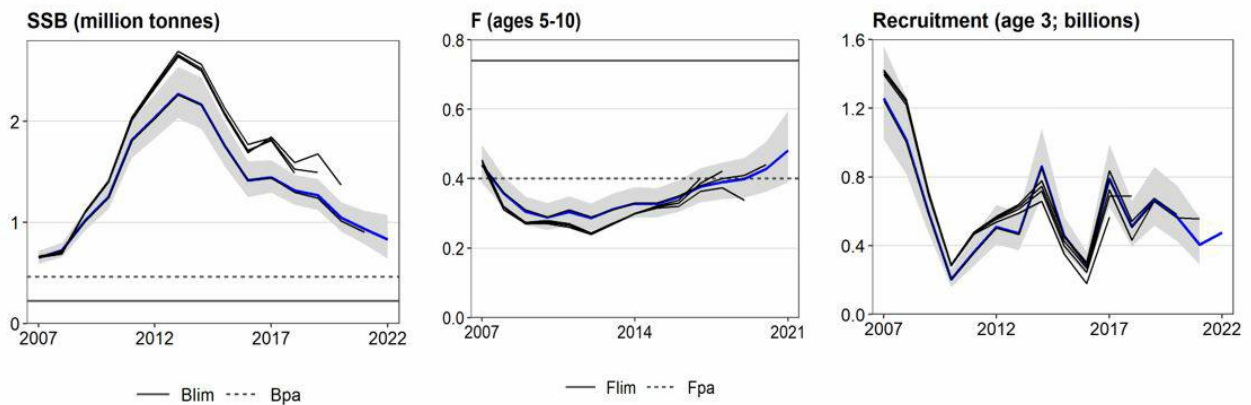


Figure 2 Cod in ICES subareas 1 and 2 (Northeast Arctic). Historical assessment results. There was a benchmark revision in 2021. The shaded areas indicate the 95% confidence intervals for the 2022 assessment.

Issues relevant for the advice

Due to the temporary suspension of Russian scientists from ICES, this assessment was conducted by a Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG) consisting of scientists from VNIRO (Russia) and IMR (Norway) (Howell et al., 2022).

This advice has been conducted outside ICES and should not be considered as ICES advice. However, this assessment and advice has been produced following the methodology agreed at the ICES benchmark in 2021 (ICES, 2021).

Fisheries targeting Northeast Arctic (NEA) cod take as bycatch a considerable part of the total golden redfish (*Sebastes norvegicus*) catch, and the bycatch of the latter species is still above any sustainable catch level. Measures to minimize bycatch levels are essential.

Bycatch of coastal cod should be kept as low as possible in order to avoid overfishing of the coastal cod (*Gadus morhua*) stocks.

The advice this year is considerably lower than last year due to the declining trend in stock size which is confirmed by low survey indices and below average recruitment to the stock.

Reference points

Table 4 Cod in ICES subareas 1 and 2 (Northeast Arctic). Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY B_{trigger}	460 000 t	B_{pa} , and trigger point in HCR	ICES (2003, 2021)
	F_{MSY}	0.40 – 0.60	Long-term simulations	ICES (2003, 2021)
Precautionary approach	B_{lim}	220 000 t	Change point regression	ICES (2003, 2021)
	B_{pa}	460 000 t	The lowest SSB estimate having >90% probability of remaining above B_{lim}	ICES (2003, 2021)
	F_{lim}	0.74	F corresponding to an equilibrium stock = B_{lim}	ICES (2003, 2021)
	F_{pa}	0.40	The highest F estimate having >90% probability of remaining below F_{lim}	ICES (2003, 2021)
Management plan	SSBMGT	460 000 t	Two-step (double hockey-stick) HCR, see Table 3	ICES (2017)
	FMGT	0.40 – 0.60	Two-step (double hockey-stick) HCR, see Table 3	ICES (2017)

Basis of the assessment

Table 5 Cod in ICES subareas 1 and 2 (Northeast Arctic). Basis of the assessment and advice.

ICES stock data category	1
Assessment type	Age-based analytical assessment (SAM) that uses catches in the model and in the forecast.
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling); four survey indices (Joint bottom trawl survey Barents Sea, Jan–Mar; Joint acoustic survey Barents Sea and Lofoten, Feb–Mar; Russian bottom trawl survey, October–December; Joint Ecosystem survey); annual maturity data from the four surveys; natural mortalities from annual stomach sampling.
Discards and bycatch	Discarding is considered negligible in recent years (below 5%). Bycatch is included.
Indicators	None.
Other information	The methodology of assessment adopted by the last ICES benchmark for the stock in February 2021 (ICES, 2021) was followed without exceptions.
Working group	Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG).

History of the advice, catch, and management

Table 6 Cod in ICES subareas 1 and 2 (Northeast Arctic). ICES advice, agreed TACs, the official and unreported landings, and ICES catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official catches	Unreported landings (included in ICES catches)	ICES catches
1987	Gradual reduction in F	595000	560000	552000		523071
1988	F = 0.51; TAC (Advice November 1987, revised advice May 1988)	530000 (320000–360000)	590000 (451000)	459000		434939
1989	Large reduction in F	335000	300000	348000		332481
1990	F at Flow; TAC	172000	160000	210000	25000	212000
1991	F at Flow; TAC	215000	215000	294000	50000	319158
1992	Within safe biological limits	250000	356000	421000	130000	513234
1993	Healthy stock	256000	500000	575000	50000	581611
1994	No long-term gains in increased F	649000	700000	795000	25000	771086
1995	No long-term gains in increased F	681000	700000	763000		739999
1996	No long-term gains in increased F	746000	700000	759000		732228
1997	Well below F _{med}	< 993000	850000	792000		762403
1998	F less than F _{med}	514000	654000	615000		592624
1999	Reduce F to below F _{pa}	360000	480000	506000		484910
2000	Increase B above B _{pa} in 2001	110000	390000			414870
2001	High probability of SSB > B _{pa} in 2003	263000	395000			426471
2002	Reduce F to well below 0.25	181000	395000		90000	535045

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official catches	Unreported landings (included in ICES catches)	ICES catches
2003	Reduce F to below Fpa	305000	395000		115000	551990
2004	Reduce F to below Fpa	398000	486000		117000	606445
2005	Take into account coastal cod and redfish bycatches. Apply catch rule.	485000	485000		166000	641276
2006	Take into account coastal cod and redfish bycatches. Apply amended catch rule.	471000	471000		67100	537642
2007	Take into account coastal cod and redfish bycatches. Fpa	309000	424000		41087	486883
2008	Take into account coastal cod and redfish bycatches. Apply catch rule.	409000	430000		15000	464171
2009	Take into account coastal cod and redfish bycatches. Apply catch rule.	473000	525000		0	523431
2010	Take into account coastal cod and redfish bycatches. Apply catch rule.	577500	607000		0	609983
2011	Take into account coastal cod and redfish bycatches. Apply catch rule.	703000	703000		0	719829
2012	Take into account coastal cod and redfish bycatches. Apply catch rule.	751000	751000		0	727663
2013	Take into account coastal cod and S. marinus ^^ bycatches. Apply catch rule.	940000	1000000		0	966209
2014	Take into account coastal cod and S. marinus^^ bycatches. Apply catch rule.	993000	993000		0	986449
2015	Take into account coastal cod and S. norvegicus bycatches. Apply catch rule.	894000	894000		0	864384
2016	Take into account coastal cod and S. norvegicus bycatches. Apply catch rule.	805000	894000		0	849422
2017	Take into account coastal cod and S. norvegicus bycatches. Apply management plan.	≤ 805000	890000 ^		0	868276
2018	Take into account coastal cod and S. norvegicus bycatches. Apply management plan.	712000	775000		0	778627
2019	Take into account coastal cod and S. norvegicus bycatches. Apply management plan.	674678	725000		0	692609
2020	Apply management plan	≤ 689672	738000		0	692903
2021	Apply management plan	≤ 885600	885600		0	767284^^
2022	Apply management plan	≤ 708480	708480			
2023	Apply management plan^^	≤ 566784				

^ The 2017 TAC was set according to the management plan agreed by JNRFC in October 2016.

^^ Until 2014 this species was named *Sebastes marinus* , thereafter *Sebastes norvegicus* .

^^^ In 2022 assessment and advice was carried out by the Joint Russian-Norwegian working group on Arctic

Fisheries (JRN-AFWG) which compiled catches for 2021 and gave advice for 2023.

History of catch and landings

Table 7 Cod in ICES subareas 1 and 2 (Northeast Arctic). History of commercial landings by country. All weights are in tonnes.

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain	Others	Total
1961	3934	13755	3921	8129			268377	-	158113	325780		1212	7832
1962	3109	20482	1532	6503			225615	-	175020	476760		245	9092
1963	-	18318	129	4223			205056	108	129779	417964		-	7755
1964	-	8634	297	3202			149878	-	94549	180550		585	4376
1965	-	526	91	3670			197085	-	89962	152780		816	4449
1966	-	2967	228	4284			203792	-	103012	169300		121	4837
1967	-	664	45	3632			218910	-	87008	262340		6	5726
1968	-	-	225	1073			255611	-	140387	676758		-	10740
1969	29374	-	5907	5543			305241	7856	231066	612215		133	11972
1970	26265	44245	12413	9451			377606	5153	181481	276632		-	9332
1971	5877	34772	4998	9726			407044	1512	80102	144802		215	6890
1972	1393	8915	1300	3405			394181	892	58382	96653		166	5652
1973	1916	17028	4684	16751			285184	843	78808	387196		276	7926
1974	5717	46028	4860	78507			287276	9898	90894	540801		38453	11024
1975	11309	28734	9981	30037			277099	7435	101843	343580		19368	8293
1976	11511	20941	8946	24369			344502	6986	89061	343057		18090	8674
1977	9167	15414	3463	12763			388982	1084	86781	369876		17771	9053
1978	9092	9394	3029	5434			363088	566	35449	267138		5525	6987
1979	6320	3046	547	2513			294821	15	17991	105846		9439	4405
1980	9981	1705	233	1921			232242	3	10366	115194		8789	3804
1981	12825	3106	298	2228			277818		5262	83000	14500	-	3990
1982	11998	761	302	1717			287525		6601	40311	14515	-	3637
1983	11106	126	473	1243			234000		5840	22975	14229	-	2899
1984	10674	11	686	1010			230743		3663	22256	8608	-	2776
1985	13418	23	1019	4395			211065		3335	62489	7846	4330	3079
1986	18667	591	1543	10092			232096		7581	150541	5497	3505	4301
1987	15036	1	986	7035			268004		10957	202314	16223	2515	5230
1988	15329	2551	605	2803			223412		8107	169365	10905	1862	4349
1989	15625	3231	326	3291			158684		7056	134593	7802	1273	3324
1990	9584	592	169	1437			88737		3412	74609	7950	510	1870
1991	8981	975		2613			126226		3981	119427***	3677	3278	2691
1992	11663	2		3911	3337		168460		6120	182315	6217	1209	3832
1993	17435	3572		5887	5389	9374	221051		11336	244860	8800	3907	5316
1994	22826	1962		8283	6882	36737	318395		15579	291925	14929	28568	7460
1995	22262	4912		7428	7462	34214	319987		16329	296158	15505	15742	7399
1996	17758	5352		8326	6529	23005	319158		16061	305317	15871	14851	7322
1997	20076	5353		6680	6426	4200	357825		18066	313344	17130	13303	7624
1998	14290	1197		3841	6388	1423	284647		14294	244115	14212	8217	5926

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain	Others	Total
1999	13700	2137		3019	4093	1985	223390		11315	210379	8994	5898	4849
2000	13350	2621		3513	5787	7562	192860		9165	166202	8695	5115	4148
2001	12500	2681		4524	5727	5917	188431		8698	183572	9196	5225	4264
2002	15693	2934		4517	6419	5975	202559		8977	184072	8414	5484	4450
2003	19427	2921		4732	7026	5963	191977		8711	182160	7924	6149	4369
2004	19226	3621		6187	8196	7201	212117		14004	201525	11285	6082	4894
2005	16273	3491		5848	8135	5874	207825		10744	200077	9349	7660	4752
2006	16327	4376		3837	8164	5972	201987		10594	203782	9219	6271	4705
2007	14788	3190		4619	5951	7316	199809		9298	186229	9496	5101	4457
2008	15812	3149		4955	5617	7535	196598		8287	190225	9658	7336	4491
2009	16905	3908		8585	4977	7380	224298		8632	229291	12013	7442	5234
2010	15977	4499		8442	6584	11299	264701		9091	267547	12657	9185	6099
2011	13429	1173		4621	7155	12734	331535		8210	310326	13291	17354^	7198
2012	17523	2841		8500	8520	9536	315739		11166	329943	12814	11081	7276
2013	13833	7858		8010	7885	14734	438734		12536	432314	15042	15263	9662
2014	33298	8149		6225	10864	18205	431846		14762	433479	16378	13243	9864
2015	26568	7480		6427	7055	16120	377983		11778	381778	19905	9880	8643
2016	24084	7946		6336	8607	16031	348949		13583	394107	14640	15139	8494
2017	28637	9554		5977	13638	11925	357419		16731	396180	14414	13802	8682
2018	26152	6605		9768	12743	10708	333539		11533	340364	13143	14071	7786
2019	22270	6371		8470	7553	12294	282120		11214	316813	13939	11565	6926
2020	21679	5796		9725	7391	9734	289472		12113	312683	11403	12908	6929
2021*	21767	4459		6190	8246	8933	337931		5426	352064	11080	11188	76728

* Provisional figures

** USSR prior to 1991.

*** Includes Baltic countries.

^ Includes unspecified EU catches.

^^ In 2022 assessment and advice was carried out by the Joint Russian-Norwegian working group on Arctic Fisheries (JRN-AFWG) which compiled catches for 2021 and gave advice for 2023.

Summary of the assessment

Table 8 Cod in ICES subareas 1 and 2 (Northeast Arctic). Assessment summary. High and low refer to 95% confidence bounds.

Year	Recruitment			Spawning-stock biomass			Total catch	Fishing mortality		
	Recruitment (Age 3)	Low	High	SSB	Low	High		F (ages 5–10)	Low	High
	thousands			tonnes		tonnes				
1946	1138875	782138	1658322	952394	800278	1133424	706000	0.25	0.21	0.30
1947	583558	406249	838254	903494	767125	1064105	882017	0.31	0.27	0.36
1948	441494	304979	639116	785218	662089	931244	774295	0.35	0.30	0.40
1949	624817	438580	890135	595220	511235	693002	800122	0.37	0.32	0.42
1950	1024284	721555	1454022	536083	470910	610274	731982	0.38	0.34	0.44
1951	2440524	1722717	3457422	494974	439859	556994	827180	0.41	0.36	0.47
1952	2338131	1665575	3282265	488811	431155	554178	876795	0.46	0.40	0.52
1953	2420273	1727540	3390787	412127	361301	470104	695546	0.41	0.36	0.47
1954	830203	593342	1161619	408122	360653	461838	826021	0.44	0.39	0.50
1955	383411	273881	536744	328050	294286	365688	1147841	0.52	0.46	0.58
1956	747357	535098	1043812	281511	253752	312306	1343068	0.57	0.50	0.64
1957	1431849	1027632	1995065	212384	190996	236168	792557	0.53	0.47	0.60
1958	935015	673291	1298478	205396	182848	230723	769313	0.53	0.47	0.59
1959	1313367	949345	1816972	434343	384862	490185	744607	0.55	0.49	0.61
1960	1480277	1069849	2048160	384643	338373	437241	622042	0.54	0.48	0.61
1961	1552082	1120517	2149864	386423	342928	435434	783221	0.63	0.57	0.71
1962	1252752	903572	1736872	315358	283371	350956	909266	0.74	0.66	0.83
1963	902995	647619	1259074	216125	194637	239986	776337	0.81	0.72	0.91
1964	469311	334131	659181	200521	179765	223675	437695	0.68	0.61	0.76
1965	873429	623953	1222653	108075	96093	121551	444930	0.58	0.51	0.65
1966	1844528	1325158	2567455	120996	108786	134575	483711	0.55	0.49	0.62
1967	1313542	943608	1828505	128675	115600	143229	572605	0.56	0.50	0.63
1968	183211	131394	255461	222846	202698	244998	1074084	0.60	0.54	0.67
1969	110531	79203	154250	148914	134220	165216	1197226	0.71	0.63	0.79
1970	206006	147361	287991	242143	218024	268931	933246	0.70	0.62	0.78
1971	403526	289987	561519	330542	293662	372054	689048	0.65	0.58	0.72
1972	1047601	758424	1447038	353348	311488	400834	565254	0.66	0.59	0.74
1973	1724173	1242601	2392381	334063	290330	384383	792685	0.63	0.56	0.70
1974	566400	413586	775676	158939	135580	186324	1102433	0.61	0.55	0.69
1975	608427	443913	833908	133486	119429	149197	829377	0.66	0.59	0.73
1976	605952	439171	836069	167229	151573	184501	867463	0.71	0.63	0.78
1977	372123	272044	509019	336160	299571	377219	905301	0.82	0.74	0.91
1978	624267	454466	857510	227984	199625	260370	698715	0.85	0.77	0.95
1979	202902	147738	278663	180487	157496	206834	440538	0.77	0.69	0.86
1980	130635	97401	175208	108443	96722	121584	380434	0.76	0.68	0.85
1981	144064	109407	189700	161275	145980	178172	399038	0.79	0.71	0.88

Year	Recruitment			Spawning-stock biomass			Total catch	Fishing mortality		
	Recruitment (Age 3)	Low	High	SSB	Low	High		F (ages 5–10)	Low	High
1982	183023	141677	236435	321134	288135	357912	363730	0.77	0.70	0.86
1983	141058	109207	182199	311281	280024	346028	289992	0.79	0.72	0.88
1984	442631	346267	565813	243444	222178	266746	277651	0.87	0.79	0.96
1985	532740	426361	665662	195314	178305	213945	307920	0.81	0.73	0.90
1986	1374811	1088311	1736734	164104	150059	179463	430113	0.87	0.79	0.96
1987	359158	283816	454500	115090	104590	126643	523071	0.93	0.84	1.02
1988	335224	265442	423350	191447	172994	211869	434939	0.88	0.79	0.98
1989	158192	126445	197908	237375	212469	265201	332481	0.67	0.59	0.75
1990	131207	103152	166892	302447	265353	344727	212000	0.42	0.37	0.49
1991	297393	234942	376444	635130	563772	715520	319158	0.41	0.36	0.47
1992	716809	574041	895083	803817	721517	895506	513234	0.49	0.43	0.55
1993	990119	793107	1236070	702294	635110	776585	581611	0.59	0.53	0.65
1994	752658	602055	940934	572233	522081	627203	771086	0.74	0.67	0.83
1995	539812	432099	674374	534987	487262	587387	739999	0.77	0.69	0.85
1996	405894	323974	508530	551598	497542	611527	732228	0.79	0.71	0.88
1997	783453	625057	981989	545940	487868	610924	762403	0.94	0.85	1.03
1998	1059540	842440	1332586	386207	345734	431417	592624	0.94	0.85	1.03
1999	630159	500729	793044	281001	252563	312642	484910	0.94	0.85	1.03
2000	749764	598404	939410	255917	234261	279574	414868	0.85	0.77	0.93
2001	593562	474176	743007	383996	347249	424632	426471	0.74	0.66	0.82
2002	375075	300119	468751	521728	471558	577234	535045	0.68	0.61	0.75
2003	759779	609712	946781	572476	518740	631778	551990	0.63	0.57	0.70
2004	243027	197964	298347	666767	605279	734501	606445	0.70	0.63	0.78
2005	697364	566863	857907	580090	528005	637313	641276	0.70	0.63	0.79
2006	539345	438026	664101	584912	532896	642006	537642	0.60	0.54	0.68
2007	1259517	1017658	1558856	652597	590777	720887	486883	0.44	0.39	0.50
2008	1017985	817139	1268197	724270	655805	799883	464171	0.36	0.31	0.41
2009	590038	472546	736744	1016900	922564	1120883	523430	0.31	0.27	0.35
2010	204469	159393	262293	1250449	1132899	1380195	609983	0.29	0.25	0.33
2011	362283	284905	460676	1814926	1637923	2011058	719830	0.30	0.27	0.35
2012	509539	407251	637518	2037769	1832296	2266284	727663	0.29	0.25	0.33
2013	472255	373147	597686	2271239	2033274	2537056	966209	0.31	0.27	0.36
2014	860386	684467	1081519	2164925	1925998	2433493	986449	0.33	0.29	0.38
2015	457348	367001	569936	1761651	1555581	1995019	864384	0.33	0.29	0.37
2016	289567	229763	364936	1417485	1250256	1607082	849422	0.35	0.31	0.40
2017	788999	627885	991456	1446266	1293939	1616526	868276	0.38	0.33	0.43
2018	510445	395509	658782	1314594	1176049	1469459	778627	0.39	0.34	0.45
2019	666503	516961	859304	1267579	1122835	1430981	692609	0.40	0.35	0.46
2020	568171	429495	751622	1045938	910513	1201505	692903	0.43	0.36	0.51

Year	Recruitment			Spawning-stock biomass			Total catch	Fishing mortality		
	Recruitment (Age 3)	Low	High	SSB	Low	High		F (ages 5–10)	Low	High
2021	406025	293498	561694	936281	786002	1115291	767284	0.48	0.39	0.60
2022	476000*			832958	642510	1075459				

* Recruitment model estimate.

References

[Howell et al. 2022. Report of the Joint Russian-Norwegian Working Group on Arctic Fisheries \(JRN-AFWG\). IMR-PINRO no.6-2022.](#)

ICES. 2003. Report of the Study Group on Biological Reference Points for Northeast Arctic Cod, 13–17 January 2003,

Svanhovd, Norway. ICES CM 2003/ACFM:11. 39 pp.

ICES. 2016. Report of the second Workshop on Management Plan Evaluation on Northeast Arctic cod and haddock and Barents Sea capelin (WKNEAMP-2) , 25-28 January 2016, Kirkenes, Norway. ICES CM 2016/ACOM:47, 76 pp.

ICES. 2017. Report of the Arctic Fisheries Working Group (AFWG), 19–25 April 2017, ICES HQ, Copenhagen, Denmark. ICES CM 2017/ACOM:06. 493 pp.

ICES. 2021. Benchmark Workshop for Barents Sea and Faroese Stocks (WKBARFAR 2021).

ICES Scientific Reports. 2021. 3:21. 205 pp. <https://doi.org/10.17895/ices.pub.7920>



Institute of Marine Research – IMR



Polar branch of the FSBSI "VINRO" ("PINRO")