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JOINT REPORT

Advice on fishing opportunities for Northeast Arctic cod in 2024 in ICES subareas 1 and 2

Institute of Marine Research – IMR

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Title (English and Norwegian):

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Content

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

Advice on fishing opportunities

The Joint Russian-Norwegian Arctic Fisheries Working Group (JRN-AFWG) advises that when the Joint Norwegian–Russian Fisheries Commission management plan is applied, catches in 2024 should be no more than 453 427 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.

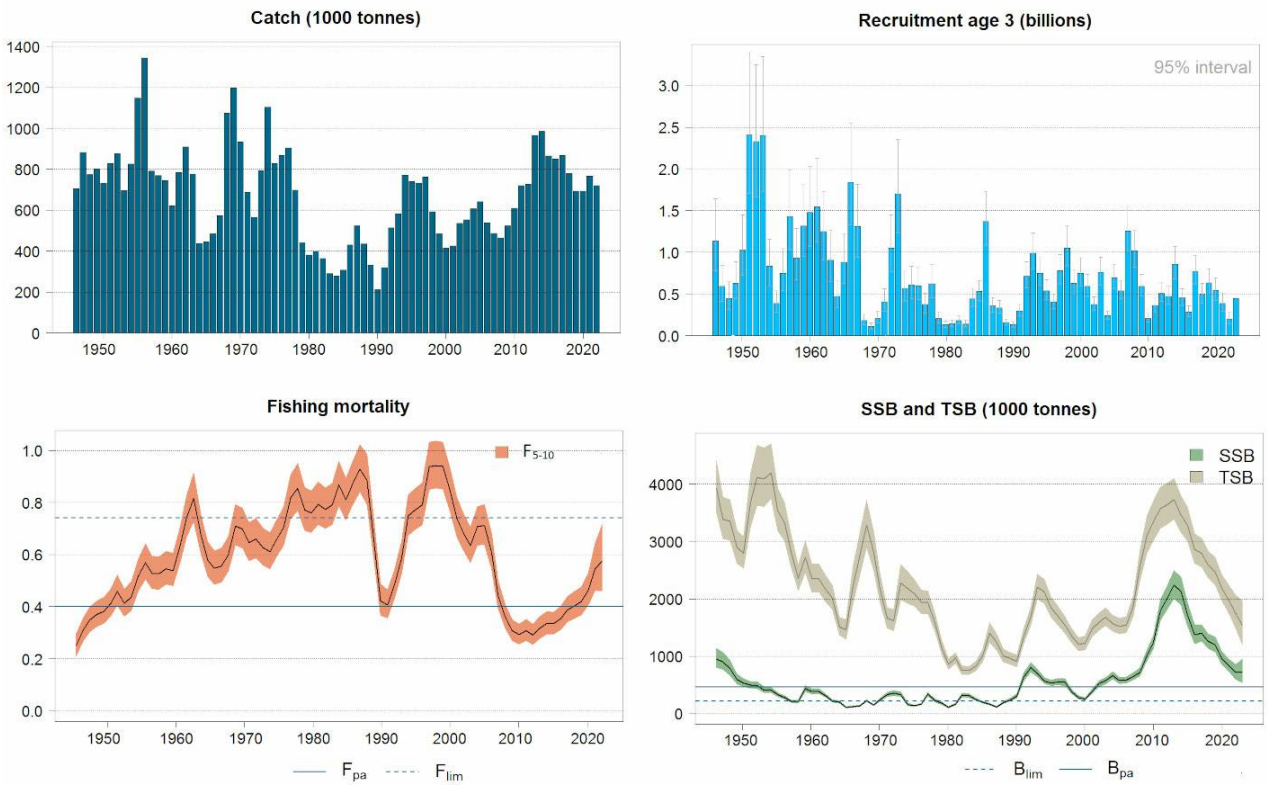

Figure 1 Cod in ICES subareas 1 and 2 (Northeast Arctic). Catch, recruitment, F, SSB and TSB (total stock biomass, age 3+) with 95 % confidence levels. The biomass reference points relate to SSB. For this stock, Fmgt ranges from 0.40 to 0.60, and there are three SSB mgt values (460 000, 920 000 and 1 380 000 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 (2023)	0.574	F_{sq} =F_{2022}. From assessment
SSB (2024)	587 836	From assessment
R age 3 (2023)	446 000	From recruitment model
R age 3 (2024)	409 000	From recruitment model

Variable	Value	Notes
R age 3 (2025)	239 000	From recruitment model
Total catch (2023)	572 800	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 (2024)	$F_{5\text{-}10}$ (2024)	SSB(2025)	% SSB change*	% TAC change**	% Advice change***
ICES advice basis						
Management plan^	453 427	0.540	506 615	-14	-20	-20
Other options						
F = 0 .40****	357 377	0.40	586 401	0	-37	-37
F = 0	0	0	900 153	53	-100	-100
F = F_{2022}	475 016	0.574	489 013	-17	-16	-16
F_{pa}	357 377	0.40	586 401	0	-37	-37
F_{lim}	571 054	0.74	412 367	-30	1	1

* SSB 2025 relative to SSB 2024.

** Advice for 2024 relative to TAC for 2023 (566 784 tonnes).

*** Advice for 2024 relative to advice for 2023.

**** F = 0.40 corresponds to the lower bound of the F_{MSY} range (0.40-0.60).

^ Since SSB in 2024 is between B_{pa} = 460 000 tonnes and 2 × B_{pa} = 920 000 tonnes, F = 0.40 is used in the 3-year prediction, giving catches of 357 377, 354 196 and 355 390 tonnes in 2024, 2025 and 2026, respectively. The average of this is 355 655 tonnes. According to the harvest control rule (HCR), the maximum decrease in TAC is limited by 20%, giving a catch of 453 427 tonnes, which corresponds to an F of 0.540 in 2024.

The advice for 2024 is 20 % lower than the advice for 2023 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**

Advice basis	Joint Norwegian-Russian Fisheries Commission management plan
Management plan	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: 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} × F_{MSY}; - if B_{pa} ≤ SSB ≤ 2×B_{pa}, then F_{tr} = F_{MSY}; - if 2 × B_{pa} < SSB < 3 × B_{pa}, then F_{tr} = F_{MSY} × (1 + 0.5 × (SSB – 2 × B_{pa}) / B_{pa}); - if SSB ≥ 3 × B_{pa}, then F_{tr} = 1.5 × F_{MSY}; where F_{MSY} = 0.40 and B_{pa} = 460 000 tonnes. 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 ±20% compared with the previous year's TAC. In this case, F_{tr} should however not be below 0.30. 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. ICES evaluated this harvest control rule in 2016 (ICES, 2016) and 2021 (ICES, 2021) and concluded that it is precautionary.

Quality of the assessment

After the 2021 benchmark, the assessment has been fairly consistent from year to year. Recruitment predictions in recent years have been overestimates.

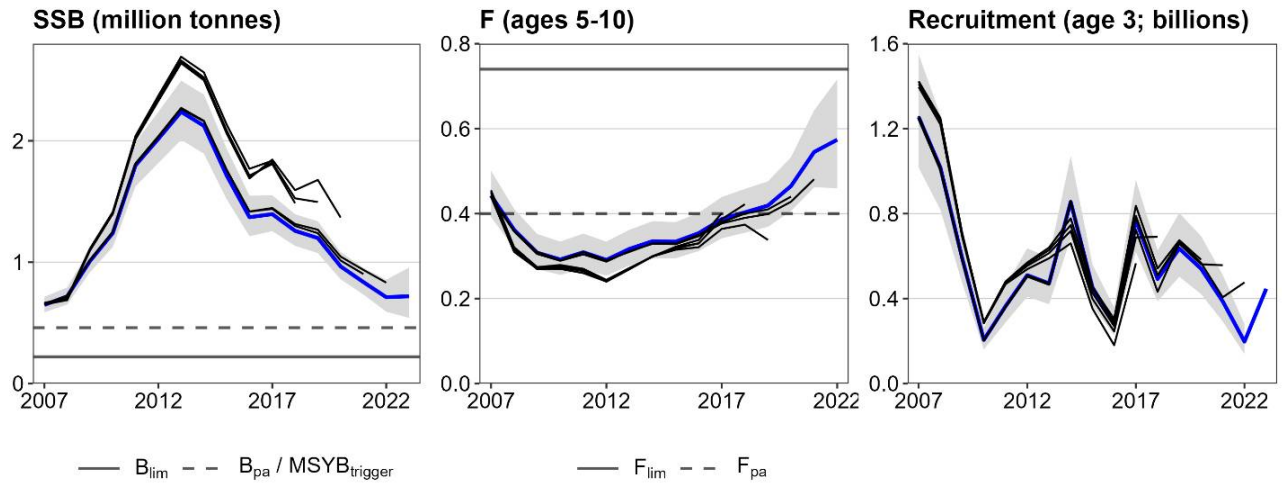

Figure 2 Cod in ICES subareas 1 and 2 (Northeast Arctic). Historical assessment results. There was a benchmark revision in 2021. The shaded areas indicate the 95% confidence intervals for the 2023 assessment.

Issues relevant for the advice

Due to the temporary suspension of Russian scientists from ICES, this assessment was as in 2022 conducted by a Joint Russian-Norwegian Arctic Fisheries Working Group (JRN-AFWG) consisting of scientists from VNIRO (Russia) and IMR (Norway) (Howell et al., 2023).

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 2022 data from the ecosystem survey were not included due to incomplete spatial coverage and poor synopticity.

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.

Recruitment has been below average after the 2014 year class. The medium-term predictions for 2025 and following years indicate that a further 20% reduction in catch from 2024 to 2025 will be advised and then catches will stabilize around 350 000 tonnes and stock size will also stabilize around 1.3 million tonnes. However, SSB is now approaching B_{pa} , below which level recruitment may be impaired. Should SSB fall below B_{pa} , then according to the management plan the 20 % stability constraint on the advised quota will no longer be applied.

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} range	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	SSB_{mgt}	460 000 t	Two-step (double hockey-stick) HCR, see Table 3	ICES (2017)
	F_{mgt}	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.
Working group	Joint Russian-Norwegian Arctic Fisheries Working Group (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 Fmed	< 993000	850000	792000		762403
1998	F less than Fmed	514000	654000	615000		592624
1999	Reduce F to below Fpa	360000	480000	506000		484910
2000	Increase B above Bpa in 2001	110000	390000			414870
2001	High probability of SSB> Bpa in 2003	263000	395000			426471
2002	Reduce F to well below 0.25	181000	395000		90000	535045
2003	Reduce F to below Fpa	305000	395000		115000	551990
2004	Reduce F to below Fpa	398000	486000		117000	606445

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official catches	Unreported landings (included in ICES catches)	ICES catches
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		0	719211^^^
2023	Apply management plan^^^	≤ 566784	566784			
2024	Apply management plan^^^	≤ 453427				

^ 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 and 2023 assessment and advice was carried out by the Joint Russian-Norwegian Arctic Fisheries working group (JRN-AFWG) which compiled catches for 2021 and 2022 and gave advice for 2023 and 2024.

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	T
1961	3934	13755	3921	8129			268377	-	158113	325780		1212	
1962	3109	20482	1532	6503			225615	-	175020	476760		245	
1963	-	18318	129	4223			205056	108	129779	417964		-	
1964	-	8634	297	3202			149878	-	94549	180550		585	
1965	-	526	91	3670			197085	-	89962	152780		816	
1966	-	2967	228	4284			203792	-	103012	169300		121	
1967	-	664	45	3632			218910	-	87008	262340		6	
1968	-	-	225	1073			255611	-	140387	676758		-	
1969	29374	-	5907	5543			305241	7856	231066	612215		133	
1970	26265	44245	12413	9451			377606	5153	181481	276632		-	
1971	5877	34772	4998	9726			407044	1512	80102	144802		215	
1972	1393	8915	1300	3405			394181	892	58382	96653		166	
1973	1916	17028	4684	16751			285184	843	78808	387196		276	
1974	5717	46028	4860	78507			287276	9898	90894	540801		38453	
1975	11309	28734	9981	30037			277099	7435	101843	343580		19368	
1976	11511	20941	8946	24369			344502	6986	89061	343057		18090	
1977	9167	15414	3463	12763			388982	1084	86781	369876		17771	
1978	9092	9394	3029	5434			363088	566	35449	267138		5525	
1979	6320	3046	547	2513			294821	15	17991	105846		9439	
1980	9981	1705	233	1921			232242	3	10366	115194		8789	
1981	12825	3106	298	2228			277818		5262	83000	14500	-	
1982	11998	761	302	1717			287525		6601	40311	14515	-	
1983	11106	126	473	1243			234000		5840	22975	14229	-	
1984	10674	11	686	1010			230743		3663	22256	8608	-	
1985	13418	23	1019	4395			211065		3335	62489	7846	4330	
1986	18667	591	1543	10092			232096		7581	150541	5497	3505	
1987	15036	1	986	7035			268004		10957	202314	16223	2515	
1988	15329	2551	605	2803			223412		8107	169365	10905	1862	
1989	15625	3231	326	3291			158684		7056	134593	7802	1273	
1990	9584	592	169	1437			88737		3412	74609	7950	510	
1991	8981	975		2613			126226		3981	119427***	3677	3278	
1992	11663	2		3911	3337		168460		6120	182315	6217	1209	
1993	17435	3572		5887	5389	9374	221051		11336	244860	8800	3907	
1994	22826	1962		8283	6882	36737	318395		15579	291925	14929	28568	

Year	Faroe Islands	France	German Dem.Rep.	Fed.Rep. Germany	Greenland	Iceland	Norway	Poland	United Kingdom	Russia**	Spain	Others	T
1995	22262	4912		7428	7462	34214	319987		16329	296158	15505	15742	
1996	17758	5352		8326	6529	23005	319158		16061	305317	15871	14851	
1997	20076	5353		6680	6426	4200	357825		18066	313344	17130	13303	
1998	14290	1197		3841	6388	1423	284647		14294	244115	14212	8217	
1999	13700	2137		3019	4093	1985	223390		11315	210379	8994	5898	
2000	13350	2621		3513	5787	7562	192860		9165	166202	8695	5115	
2001	12500	2681		4524	5727	5917	188431		8698	183572	9196	5225	
2002	15693	2934		4517	6419	5975	202559		8977	184072	8414	5484	
2003	19427	2921		4732	7026	5963	191977		8711	182160	7924	6149	
2004	19226	3621		6187	8196	7201	212117		14004	201525	11285	6082	
2005	16273	3491		5848	8135	5874	207825		10744	200077	9349	7660	
2006	16327	4376		3837	8164	5972	201987		10594	203782	9219	6271	
2007	14788	3190		4619	5951	7316	199809		9298	186229	9496	5101	
2008	15812	3149		4955	5617	7535	196598		8287	190225	9658	7336	
2009	16905	3908		8585	4977	7380	224298		8632	229291	12013	7442	
2010	15977	4499		8442	6584	11299	264701		9091	267547	12657	9185	
2011	13429	1173		4621	7155	12734	331535		8210	310326	13291	17354^	
2012	17523	2841		8500	8520	9536	315739		11166	329943	12814	11081	
2013	13833	7858		8010	7885	14734	438734		12536	432314	15042	15263	
2014	33298	8149		6225	10864	18205	431846		14762	433479	16378	13243	
2015	26568	7480		6427	7055	16120	377983		11778	381778	19905	9880	
2016	24084	7946		6336	8607	16031	348949		13583	394107	14640	15139	
2017	28637	9554		5977	13638	11925	357419		16731	396180	14414	13802	
2018	26152	6605		9768	12743	10708	333539		11533	340364	13143	14071	
2019	22270	6371		8470	7553	12294	282120		11214	316813	13939	11565	
2020	21679	5796		9725	7391	9734	289472		12113	312683	11403	12908	
2021	21767	4459		6190	8246	8933	337931		5426	352064	11080	11188	7
2022*	21530	4988		7134	7688	6214	310145		7024	333697	12214	8577	7

* Provisional figures

** USSR prior to 1991.

*** Includes Baltic countries.

^ Includes unspecified EU catches.

^^ In 2022 and 2023 assessment and advice was carried out by the Joint Russian-Norwegian Arctic Fisheries working group (JRN-AFWG) which compiled catches for 2021 and 2022 and gave advice for 2023 and 2024.

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	1131733	781426	1639078	952756	800517	1133947	706000	0.25	0.21	0.297
1947	589231	412364	841960	903304	767137	1063639	882017	0.309	0.268	0.357
1948	449846	312706	647128	785151	662274	930827	774295	0.348	0.303	0.4
1949	626523	442032	888016	595159	511249	692840	800122	0.369	0.323	0.422
1950	1024221	725123	1446690	536002	470975	610007	731982	0.382	0.335	0.436
1951	2407714	1708528	3393032	495064	440346	556581	827180	0.413	0.363	0.469
1952	2328597	1666298	3254138	488824	431608	553625	876795	0.459	0.404	0.522
1953	2402267	1722497	3350304	412181	361649	469774	695546	0.412	0.362	0.468
1954	833170	598061	1160703	408246	361032	461635	826021	0.438	0.386	0.497
1955	385036	276191	536778	328014	294465	365385	1147841	0.519	0.46	0.585
1956	750321	539501	1043523	281300	253788	311795	1343068	0.57	0.505	0.643
1957	1431458	1031662	1986186	212225	191029	235773	792557	0.528	0.468	0.595
1958	929503	672056	1285573	205350	182986	230448	769313	0.526	0.467	0.591
1959	1312954	952699	1809437	434392	385395	489618	744607	0.546	0.486	0.613
1960	1476784	1071422	2035511	384764	338846	436904	622042	0.539	0.479	0.606
1961	1544518	1119487	2130919	386646	343405	435331	783221	0.634	0.568	0.707
1962	1247843	903580	1723271	315444	283722	350713	909266	0.743	0.666	0.827
1963	907862	653790	1260669	216030	194731	239659	776337	0.815	0.727	0.914
1964	473547	338597	662283	200204	179696	223053	437695	0.678	0.606	0.758
1965	878677	630292	1224945	107974	96100	121315	444930	0.578	0.514	0.65
1966	1839953	1327238	2550732	121031	108952	134449	483711	0.548	0.487	0.616
1967	1308974	944125	1814816	128774	115835	143159	572605	0.556	0.494	0.625
1968	182936	131716	254074	223025	203117	244884	1074084	0.599	0.536	0.67
1969	111045	79892	154347	148985	134427	165120	1197226	0.71	0.635	0.792
1970	206796	148561	287857	242030	218197	268466	933246	0.698	0.625	0.779
1971	406737	293540	563586	330272	293895	371152	689048	0.646	0.577	0.723
1972	1052751	765031	1448681	353277	311941	400090	565254	0.659	0.587	0.739
1973	1700149	1229756	2350472	334102	290855	383779	792685	0.627	0.56	0.703
1974	565981	414583	772666	158993	135790	186160	1102433	0.611	0.546	0.685
1975	610161	446588	833648	133549	119560	149175	829377	0.658	0.591	0.732
1976	599582	436054	824436	167188	151704	184253	867463	0.705	0.635	0.783
1977	372307	273059	507629	336002	299922	376423	905301	0.817	0.736	0.907
1978	621548	454061	850816	227858	199872	259761	698715	0.855	0.77	0.95
1979	204031	149163	279081	180352	157650	206324	440538	0.772	0.693	0.859

1980	131519	98463	175674	108439	96843	121423	380434	0.76	0.684	0.845
1981	144577	110226	189635	161362	146224	178068	399038	0.793	0.715	0.879
1982	181947	141264	234346	321353	288699	357700	363730	0.774	0.699	0.857
1983	140981	109477	181550	311520	280575	345878	289992	0.791	0.715	0.874
1984	443366	347905	565021	243628	222591	266654	277651	0.868	0.786	0.958
1985	529829	425095	660367	195463	178630	213881	307920	0.809	0.733	0.894
1986	1369810	1087193	1725895	164102	150226	179259	430113	0.873	0.793	0.962
1987	357271	283078	450909	115111	104735	126515	523071	0.928	0.842	1.023
1988	334096	265195	420897	191558	173316	211720	434939	0.884	0.793	0.986
1989	158520	127033	197810	237290	212684	264742	332481	0.667	0.594	0.749
1990	132388	104361	167942	303044	266322	344828	212000	0.422	0.366	0.487
1991	298599	236478	377039	636493	565917	715869	319158	0.407	0.357	0.464
1992	714479	573702	889802	804452	723148	894898	513234	0.485	0.433	0.544
1993	988559	794000	1230793	701423	635092	774681	581611	0.586	0.526	0.652
1994	749508	601265	934300	570797	521257	625045	771086	0.747	0.673	0.83
1995	537661	431639	669725	533335	486300	584919	739999	0.771	0.697	0.854
1996	402269	321983	502573	550636	497293	609701	732228	0.791	0.714	0.876
1997	777417	621950	971746	545650	488212	609845	762403	0.937	0.851	1.032
1998	1048459	836046	1314841	385769	345766	430401	592624	0.941	0.855	1.035
1999	626609	499228	786493	280600	252500	311828	484910	0.939	0.853	1.032
2000	747832	598408	934569	255331	233975	278637	414868	0.848	0.768	0.936
2001	591465	473742	738441	383395	347133	423445	426471	0.739	0.666	0.82
2002	374563	300534	466828	520889	471374	575605	535045	0.679	0.612	0.754
2003	757474	609542	941308	571223	518205	629664	551990	0.634	0.569	0.705
2004	242780	198236	297334	665197	604504	731983	606445	0.707	0.637	0.785
2005	694272	565628	852175	578178	526828	634532	641276	0.711	0.638	0.793
2006	538504	438414	661446	581768	530654	637805	537642	0.61	0.543	0.684
2007	1254871	1016429	1549250	647938	587310	714824	486883	0.443	0.392	0.501
2008	1016970	818493	1263575	718024	651175	791736	464171	0.362	0.318	0.411
2009	590980	474494	736061	1008860	916837	1110118	523430	0.308	0.269	0.352
2010	205517	160601	262996	1239289	1124664	1365596	609983	0.292	0.256	0.334
2011	363991	286985	461659	1798145	1625479	1989153	719830	0.309	0.269	0.353
2012	510052	408859	636292	2016129	1816113	2238173	727663	0.291	0.254	0.334
2013	471175	373624	594197	2238973	2008666	2495686	966209	0.317	0.278	0.362
2014	854919	683245	1069728	2123627	1894193	2380852	986449	0.335	0.294	0.382
2015	452525	365146	560813	1714210	1518318	1935376	864384	0.334	0.295	0.38
2016	285806	228500	357483	1370535	1213588	1547780	849422	0.354	0.312	0.402

2017	770881	619270	959609	1395722	1255582	1551503	868276	0.387	0.342	0.439
2018	492321	386933	626414	1258206	1134927	1394875	778627	0.403	0.355	0.458
2019	635422	502979	802738	1198577	1074802	1336606	692609	0.419	0.369	0.476
2020	540952	421568	694146	964937	859377	1083463	692903	0.465	0.406	0.533
2021	386652	292436	511222	835773	733382	952460	767284	0.545	0.462	0.643
2022	197418	139406	279570	711549	592344	854745	719211	0.574	0.46	0.716
2023	446000*			718754	540782	955296				

* Recruitment model estimate.

References

Howell et al. 2023. Report of the Joint Russian-Norwegian Working Group on Arctic Fisheries (JRN-AFWG) 2023. IMR-PINRO no.7-2023.

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. 3:21. 205 pp. https://doi.org/10.17895/ices.pub.7920

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