

Haddock (*Melanogrammus aeglefinus*) in subareas 1 and 2 (Northeast Arctic)

ICES advice on fishing opportunities

ICES advises that when the Joint Russian–Norwegian Fisheries Commission management plan is applied, catches in 2020 should be no more than 215 000 tonnes.

Stock development over time

The spawning-stock biomass (SSB) has been above $MSY B_{trigger}$ since 1989. Due to the strong recruitment-at-age 3 in 2007–2009 (2004–2006 year classes) the stock reached an all-time high level in 2013. SSB is now decreasing, but remains well above $MSY B_{trigger}$. Fishing mortality (F) has increased since 2013 and was above F_{MSY} in 2017 and 2018.

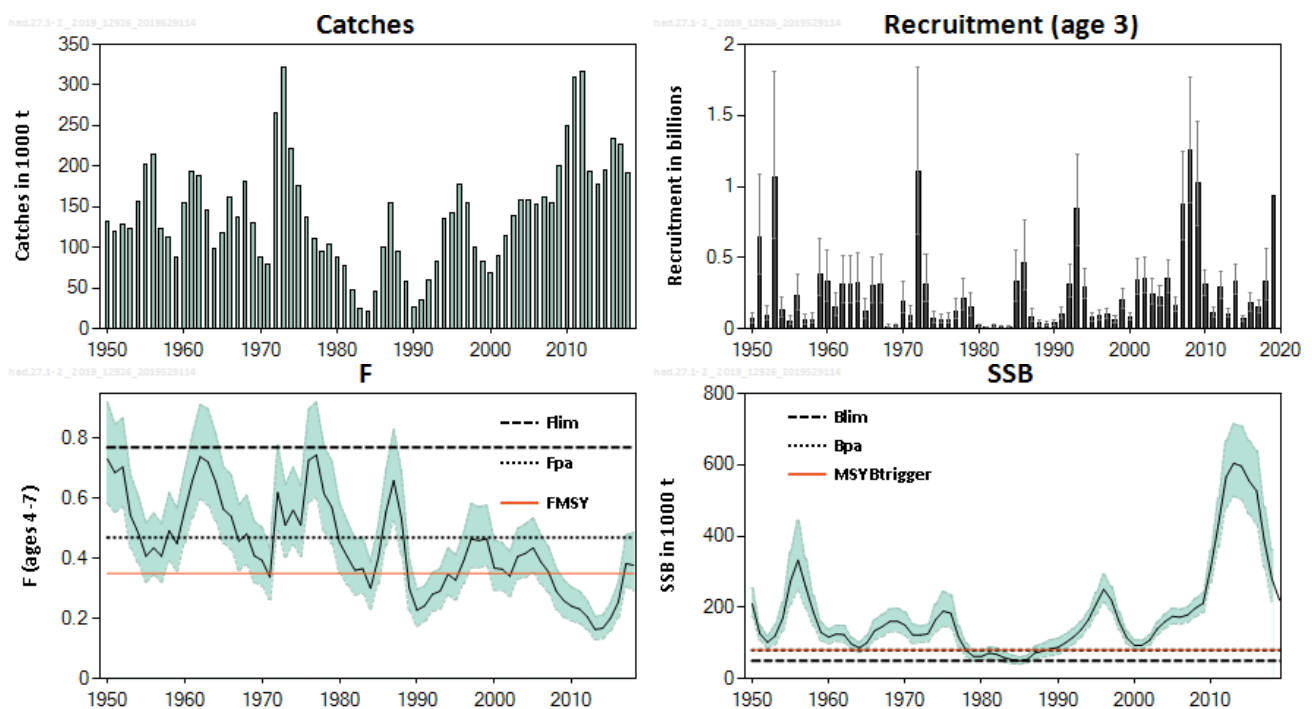


Figure 1 Haddock in subareas 1 and 2. Summary of the stock assessment (weights in thousand tonnes). Confidence intervals (95%) for recruitment, F, and SSB are shown in the plots. For this stock, $F_{MGT} = F_{MSY}$ and $SSB_{MGT} = MSY B_{trigger} = B_{pa}$; therefore, the horizontal lines representing these points in the graph overlap.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} , but below F_{pa} and F_{lim} , and that the spawning stock size is above $MSY B_{trigger}$, B_{pa} , and B_{lim} .

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

	Fishing pressure				Stock size			
	2016	2017	2018		2017	2018	2019	
Maximum sustainable yield	F_{MSY}	✓	✗	✗ Above	$MSY B_{trigger}$	✓	✓	✓ Above trigger
Precautionary approach	F_{pa}, F_{lim}	✓	✓	✓ Harvested sustainably	B_{pa}, B_{lim}	✓	✓	✓ Full reproductive capacity
Management plan	F_{MGT}	✓	✗	✗ Above	B_{MGT}	✓	✓	✓ Above

Catch scenarios

Table 2 Haddock in subareas 1 and 2. Assumptions made for the interim year and in the forecast. Recruitment is in thousands and weights are in tonnes.

Variable	Value	Notes
F _{ages 4–7} (2019)	0.34	TAC constraint, exploitation pattern from 2016–2018
SSB (2020)	216 384	Based on TAC constraint
R _{age 3} (2019)	930 100	Based on survey indices (RCT3 estimate)
R _{age 3} (2020)	629 300	Based on survey indices (RCT3 estimate)
R _{age 3} (2021)	343 900	Based on survey indices (RCT3 estimate)
Total catch (2019)	172 000	TAC set by the JNRFC, discarding assumed to be negligible

Table 3 Haddock in subareas 1 and 2. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	F _{ages 4–7} (2020)	SSB (2021)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan	215 000	0.32	268 486	24	25	41
Other scenarios						
MSY approach:						
F _{MSY}	231 352	0.35	261 810	21	35	52
F = 0	0	0	363 570	68	-100	-100
F = F ₂₀₁₈	247 231	0.38	255 407	18	44	63
F _{pa}	297 101	0.47	235 810	9	73	95
F _{lim}	438 518	0.77	184 630	-15	155	188

* SSB 2021 relative to SSB 2020.

** Catch in 2020 relative to TAC in 2019 (172 000 tonnes).

*** Catch value for 2020 relative to advice value for 2019 (152 000 tonnes).

The advised catch for 2020 is considerably higher than that advised for 2019 because the strong year classes of 2016 and 2017 will recruit to the fishery in 2020.

Basis of the advice

Table 4 Haddock in subareas 1 and 2. The basis of the advice.

Advice basis	Joint Russian–Norwegian Fisheries Commission management plan.
Management plan	The current HCR for haddock is as follows (see details in Protocol of the 46th Session of the Joint Russian–Norwegian Fisheries Commission – JNRFC, 2016):
	<i>TAC for the next year will be set at level corresponding to FMSY.</i>
	<i>The TAC should not be changed by more than ±25% compared with the previous year TAC.</i>
	<i>If the spawning stock falls below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from FMSY at B_{pa} to F = 0 at SSB equal to zero. At SSB-levels below B_{pa} in any of the operational years (current year and a year ahead) there should be no limitations on the year-to-year variations in TAC.</i>
	At the 46th Session of the Joint Russian–Norwegian Fisheries Commission in 2016 it was decided to keep the existing HCR for haddock for the next five years.
Quota flexibility: 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.	
ICES evaluated this HCR in 2016 (ICES, 2016) and concluded that it is precautionary.	

Quality of the assessment

This year's assessment is consistent with last year's assessment. However, the retrospective pattern in SSB in previous years raises concerns about the reliability of the assessment; this will be investigated in a benchmark prior to the next assessment.

For this year's assessment only indices from the Joint Barents Sea winter survey for 2019 were used, since the Russian bottom trawl survey was not conducted in 2018 and the joint ecosystem survey had a complete lack of coverage in the southeastern part of the survey area where most of the haddock is distributed. This adds uncertainty in the final year.

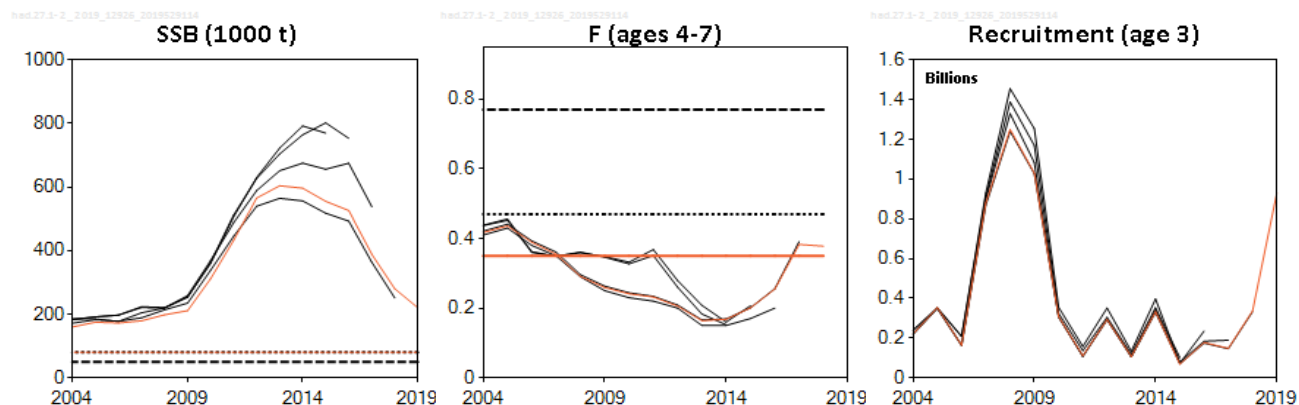


Figure 2 Haddock in subareas 1 and 2. Historical assessment results. For the 2015–2016 assessments, the fishing mortality plot shows F+M2 (natural mortality due to predation by cod), instead of only F.

Issues relevant for the advice

There is a likelihood of higher catch of undersized fish in the next year(s) due to strong cohorts entering the fisheries. It is therefore important that the fishery is regulated by spatial and temporal closures in the next couple of years as this will reduce the likelihood of high catch and possible discarding of undersized fish of the abundant 2016–2017 year classes.

The short-term forecast indicates a significant increase in SSB in 2021. This increase is highly dependent on the strength of the large incoming year classes, which are uncertain estimates. They are estimated to contribute almost 60% of the total stock biomass in 2020, and over 40% of the catches. However, the harvest control rule states that: “(the) TAC should not be changed by more than $\pm 25\%$ compared with the previous year TAC”. This provides a buffer to the uncertainty in estimation of incoming year class strength.

Reference points

Table 5 Haddock in subareas 1 and 2. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	80 000 tonnes	B_{pa} .	ICES (2011)
	F_{MSY}	0.35	Stochastic long-term simulations.	ICES (2011)
Precautionary approach	B_{lim}	50 000 tonnes	B_{loss} .	ICES (2011)
	B_{pa}	80 000 tonnes	$B_{lim} \times \exp(1.645 \times \sigma)$, where $\sigma = 0.3$.	ICES (2011)
	F_{lim}	0.77	Determined from replacement line leading from SSB = 0 to the geometric mean recruitment at SSB = B_{lim} .	ICES (2011)
	F_{pa}	0.47	$F_{lim} \times \exp(-1.645 \times \sigma)$, where $\sigma = 0.3$.	ICES (2011)
Management plan	SSB_{MGT}	80 000 tonnes	B_{pa} .	ICES (2011)
	F_{MGT}	0.35	Previous F_{pa} estimated prior to the revision of the historical time-series for this stock.	ICES (2011)

Basis of the assessment

Table 6 Haddock in subareas 1 and 2. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2018).
Assessment type	Age-based analytical assessment (SAM; ICES, 2019) that uses catches in the model and in the forecast.
Input data	Commercial landings (international landings, ages and length frequencies from catch sampling); four survey indices (RU-BTr-Q4, BS-NoRU-Q1(Aco), BS-NoRu-Q1 (BTr), and Eco-NoRu-Q3 (Btr)); annual maturity data from surveys; natural mortalities from cod consumption of ages 3–6 haddock are used from 1984.
Discards and bycatch	Discarding is considered negligible in recent years. Bycatch is included.
Indicators	None.
Other information	Last benchmarked in January 2015 (WKARCT; ICES, 2015). The implementation in SAM of predation by cod on haddock has been changed since 2016. Next benchmark is scheduled for January 2020.
Working group	Arctic Fisheries Working Group (AFWG).

Information from stakeholders

There is no additional available information.

History of the advice, catch, and management

Table 7 Haddock in subareas 1 and 2. ICES advice, TACs, and official and ICES landings. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official landings*	Unreported landings	ICES landings**
1987	No increase in F; TAC	160 000	250 000	154 916		154 916
1988	No increase in F	< 240 000	240 000	95 255		95 255
1989	Large reduction in F	69 000	83 000	58 518		58 518
1990	No directed fishery	-	25 000	27 182		27 182
1991	No directed fishery	-	28 000	36 216		36 216
1992	Within safe biological limits	35 000	63 000	59 922		59 922
1993	No long-term gains in increasing F	56 000	72 000	82 379		82 379
1994	No long-term gains in $F > F_{med}$	97 000***	120 000	135 186		135 186
1995	No long-term gains in $F > F_{med}$	122 000***	130 000	142 448		142 448
1996	No long-term gains in $F > F_{med}$	169 000***	170 000	178 128		178 128
1997	Well below F_{med}	< 242 000	210 000	154 359		154 359
1998	Below F_{med}	< 120 000	130 000	100 630		100 630
1999	Reduce F below F_{pa}	< 74 000	78 000	83 195		83 195
2000	Reduce F below F_{pa}	< 37 000	62 000	68 944		68 944
2001	Reduce F below F_{pa}	< 66 000	85 000	89 640		89 640
2002	Reduce F below F_{pa}	< 64 000	85 000	96 062	18 736	114 798
2003	Reduce F below F_{pa}	< 101 000	101 000	105 700	33 226	138 926
2004	Reduce F below F_{pa}	< 120 000	130 000	124 502	33 777	158 279
2005	Reduce F below F_{pa}	< 106 000	117 000	118 015	40 283	158 298
2006	Reduce F below F_{pa}	< 112 000	120 000	131 706	21 451	153 157
2007	Limit catches	< 130 000	150 000	146 972	14 553	161 525
2008	Limit catches to 2001–2004 average	< 130 000	155 000	149 776	5 828	155 604
2009	Apply management plan	< 194 000	194 000	200 061	0	200 061
2010	Apply management plan	< 243 000	243 000	249 200	0	249 200
2011	Apply management plan	< 303 000	303 000	309 785	0	309 785
2012	Apply management plan	< 318 000	318 000	315 627	0	315 627
2013	Apply management plan	< 238 000	200 000	193 744	0	193 744
2014	Apply management plan	< 150 000	178 500	177 522	0	177 522
2015	Apply management plan	< 165 000	223 000	194 756	0	194 756
2016	Apply management plan	< 244 000^	244 000	233 416	0	233 183

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official landings*	Unreported landings	ICES landings**
2017	Apply management plan	≤ 233 000	233 000	227 588	0	227 588
2018	Apply management plan	≤ 202 305	202 305	191 276	0	191 276
2019	Apply management plan	≤ 152 000	172 000			
2020	Apply management plan	≤ 215 000				

^ This advice was updated on 7 July 2015 in response to a special request (ICES, 2015b) after a mid-year change in TAC in 2015 (from 178 500 tonnes to 223 000 tonnes).

* Coastal haddock in Norwegian statistical areas 06 and 07 (south of Lofoten) are included.

** Unreported landings in 2002–2008 are included.

*** Predicted landings at F_{med} .

History of the catch and landings

Table 8 Haddock in subareas 1 and 2. Catch distribution by fleet in 2018 as estimated by ICES.

Catch (2018)	Landings			Discards
191 276 tonnes	trawls 69%	longline 8.7%	other gears 22.3%	Discarding is unknown, but assumed to be negligible
	191 276 tonnes			

Table 9 Haddock in subareas 1 and 2. History of official commercial catch and landings by country. All weights are in tonnes.

Year	Faroe Islands	France	German Dem. Rep.	Fed. Rep. Germ.	Greenland	Norway^	Poland	Russia**	Spain	United Kingdom	Others	Unreported catches***	Total
1960	172	-	-	5 597		46 263	-	57 025		45 469	125	-	154 651
1961	285	220	-	6 304		60 862	-	85 345		39 650	558	-	193 224
1962	83	409	-	2 895		54 567	-	91 910		37 486	58	-	187 408
1963	17	363	-	2 554		59 955	-	63 526		19 809	-	-	146 224
1964	-	208	-	1 482		38 695	-	43 870		14 653	250	-	99 158
1965	-	226	-	1 568		60 447	-	41 750		14 345	242	-	118 578
1966	-	1 072	11	2 098		82 090	-	48 710		27 723	74	-	161 778
1967	-	1 208	3	1 705		51 954	-	57 346		24 158	23	-	136 397
1968	-	-	-	1 867		64 076	-	75 654		40 129	-	-	181 726
1969	2	-	309	1 490		67 549	-	24 211		37 234	25	-	130 820
1970	541	-	656	2 119		37 716	-	26 802		20 423	-	-	88 257
1971	81	-	16	896		45 715	43	15 778		16 373	3	-	78 905
1972	137	-	829	1 433		46 700	1 433	196 224		17 166	2 231	-	266 153
1973	1 212	3 214	22	9 534		86 767	34	186 534		32 408	2 501	-	322 226
1974	925	3 601	454	23 409		66 164	3 045	78 548		37 663	7 348	-	221 157
1975	299	5 191	437	15 930		55 966	1 080	65 015		28 677	3 163	-	175 758
1976	536	4 459	348	16 660		49 492	986	42 485		16 940	5 358	-	137 264
1977	213	1 510	144	4 798		40 118	-	52 210		10 878	287	-	110 158
1978	466	1 411	369	1 521		39 955	1	45 895		5 766	38	-	95 422
1979	343	1 198	10	1 948		66 849	2	26 365		6 454	454	-	103 623
1980	497	226	15	1 365		66 501	-	20 706		2 948	246	-	92 504
1981	381	414	22	2 402		63 435		13 400		1 682	-	-	81 736
1982	496	53	-	1 258		43 702		2 900	-	827	-	-	49 236
1983	428	-	1	729		22 364		680	139	259	-	-	24 600
1984	297	15	4	400		18 813		1 103	37	276	-	-	20 945
1985	424	21	20	395		21 272		22 690	77	153	-	-	45 052
1986	893	12	75	1 079		52 313		45 738	22	431	-	-	100 563
1987	464	7	83	3 105		72 419		78 211	59	563	5	-	154 916
1988	1 113	116	78	1 323		60 823		31 293	72	435	2	-	95 255
1989	1 217	-	26	171		36 451		20 062	1	590	-	-	58 518
1990	705	-	5	167		20 621		5 190	-	494	-	-	27 182
1991	1 117	-		213		22 178		12 177	-	514	17	-	36 216
1992	1 093	151		387	1 719	36 238		19 699	38	596	1	-	59 922

Year	Faroe Islands	France	German Dem. Rep.	Fed. Rep. Germ.	Greenland	Norway [^]	Poland	Russia**	Spain	United Kingdom	Others	Unreported catches***	Total
1993	546	1 215		1 165	880	40 978		35 071	76	1 802	646	-	82 379
1994	2 761	678		2 412	770	71 171		51 822	22	4 673	877	-	135 186
1995	2 833	598		2 675	1 097	76 886		54 516	14	3 111	718	-	142 448
1996	3 743	6		942	1 510	94 527		74 239	669	2 275	217	-	178 128
1997	3 327	540		972	1 877	103 407		41 228	364	2 340	304	-	154 359
1998	1 903	241		385	854	75 108		20 559	257	1 229	94	-	100 630
1999	1 913	64		641	437	48 182		30 520	652	694	92	-	83 195
2000	631	178		880	432	42 009		22 738	502	747	827	-	68 944
2001	1 210	324		554	553	49 067		34 307	1 497	1 068	1 060	-	89 640
2002	1 564	297		627	858	52 247		37 157	1 505	1 125	682	18 736	114 798
2003	1 959	382		918	1 363	56 485		41 142	1 330	1 018	1 103	33 226	138 926
2004	2 484	103		823	1 680	62 192		54 347	54	1 250	1 569	33 777	158 279
2005	2 138	333		996	15	60 850		50 012	963	1 899	1 262	40 283	158 751
2006	2 390	883		989	1 830	69 272		53 313	703	1 164	1 162	21 451	153 157
2007	2 307	277		1 123	1 464	71 244		66 569	125	1 351	2 511	14 553	161 525
2008	2 687	311		535	1 659	72 779		68 792	283	971	1 759	5 828	155 604
2009	2 820	529		1 957	1 410	104 354		85 514	317	1 315	1 845	0	200 061
2010	3 173	764		3 539	1 970	123 384		111 372	379	1 758	2 862	0	249 200
2011	1 759	268		1 724	2 110	158 202		139 912	502	1 379	4 763	0	309 785
2012	2 055	322		1 111	3 984	159 602		143 886	441	833	3 393	0	315 627
2013	1 886	342		500	1 795	99 215		85 668	439	639	3 260	0	193 744
2014	1 470	198		340	1 150	91 306		78 725	187	355	3 791	0	177 522
2015	2 459	145		124	1 047	95 094		91 864	246	450	3 327	0	194 756
2016	2 460	340		170	1 401	108 718		115 710	200	575	3 838	0	233 416
2017	2 776	108		170	1 810	113 132		106 714	228	372	2 279	0	227 588
2018*	2 333	183		385	1 317	93 839		90 486	107	453	2 173	0	191 276

* Provisional figures.

** USSR prior to 1991.

*** Figures based on Norwegian/Russian IUU estimates.

[^] Landings of coastal haddock in Norwegian statistical areas 06 and 07 (south of Lofoten) are included from 1983.

Summary of the assessment

Table 10 Haddock in subareas 1 and 2. Assessment summary.

Year	Recruitment (thousands)			SSB (tonnes)			Catch (tonnes)	F		
	Age 3	2.5 percentile	97.5 percentile	SSB	2.5 percentile	97.5 percentile		Mean F ages 4–7	2.5 percentile	97.5 percentile
1950	67909	39825	115798	210469	174737	253508	132125	0.732	0.582	0.922
1951	643146	381940	1082989	126945	108067	149121	120077	0.686	0.555	0.847
1952	95519	56772	160709	102125	86200	120993	127660	0.705	0.572	0.869
1953	1069379	631697	1810315	119871	95326	150735	123920	0.544	0.436	0.679
1954	133121	78815	224847	169170	133774	213933	156788	0.485	0.386	0.609
1955	54736	32141	93214	272359	208456	355853	202286	0.408	0.322	0.518
1956	227460	133694	386988	332172	248574	443885	213924	0.436	0.345	0.552
1957	58058	34401	97985	257612	197382	336221	123583	0.408	0.323	0.516
1958	65914	38761	112090	186839	150030	232678	112672	0.493	0.393	0.620
1959	380492	227537	636265	129867	106580	158244	88211	0.450	0.358	0.566
1960	328005	195623	549973	116575	98052	138598	154651	0.560	0.452	0.694
1961	151834	91294	252518	125149	104701	149591	193224	0.661	0.537	0.813
1962	309574	186447	514012	123602	102017	149755	187408	0.739	0.599	0.913
1963	309158	186325	512967	97043	81565	115458	146224	0.722	0.579	0.899
1964	318887	191099	532126	86600	73054	102658	99158	0.656	0.526	0.818
1965	124551	74452	208364	100233	82674	121522	118578	0.564	0.451	0.706
1966	303549	181433	507857	134158	108853	165345	161778	0.541	0.431	0.680
1967	311969	185687	524135	145559	118029	179510	136397	0.457	0.361	0.578
1968	16240	9580	27530	160493	131932	195237	181726	0.482	0.380	0.611
1969	20621	12290	34598	161338	131563	197852	130820	0.409	0.320	0.523
1970	196935	116554	332747	150069	120579	186771	88257	0.394	0.308	0.504
1971	94394	55361	160949	122811	98558	153032	78905	0.338	0.263	0.434
1972	1102790	663243	1833635	122580	101908	147445	266153	0.620	0.493	0.779
1973	317217	190923	527053	125530	103501	152247	322226	0.511	0.405	0.645
1974	71085	43019	117460	165607	131322	208841	221157	0.561	0.446	0.705
1975	60663	36808	99979	189702	147075	244684	175758	0.512	0.408	0.642
1976	65598	39642	108548	183385	143112	234992	137264	0.727	0.589	0.898
1977	125133	74676	209684	116319	91453	147947	110158	0.745	0.601	0.922
1978	214073	129010	355223	78699	61857	100128	95422	0.616	0.490	0.774
1979	151398	91008	251860	62078	49323	78131	103623	0.571	0.449	0.725
1980	18899	10989	32502	62398	50495	77106	87889	0.454	0.353	0.585
1981	9225	5454	15605	71542	57391	89183	77153	0.406	0.314	0.524
1982	16484	9804	27715	68072	53725	86251	46955	0.361	0.279	0.467
1983	9852	5806	16716	58935	46841	74153	24600	0.366	0.284	0.471
1984	14518	8589	24538	53015	42159	66667	20945	0.301	0.233	0.389
1985	329518	196308	553121	49865	40553	61317	45052	0.402	0.317	0.510
1986	458287	274143	766123	54254	44475	66183	100563	0.556	0.445	0.696
1987	83081	49261	140123	72012	56565	91678	154916	0.660	0.524	0.831
1988	38441	22566	65484	77166	60462	98484	95255	0.534	0.413	0.690
1989	31772	18787	53729	83359	63879	108780	58518	0.301	0.228	0.396
1990	39106	24100	63456	87990	68071	113738	27182	0.228	0.175	0.297
1991	103256	71851	148385	100726	80956	125325	36216	0.243	0.191	0.309
1992	312998	218071	449247	116241	96275	140347	59922	0.281	0.224	0.354
1993	848378	584630	1231113	136413	115911	160541	82379	0.292	0.233	0.367
1994	295569	207171	421687	165211	143769	189851	135186	0.348	0.278	0.437
1995	79138	55424	112997	208941	181012	241180	142448	0.328	0.262	0.411
1996	94320	66015	134760	250661	214823	292479	178128	0.391	0.316	0.484
1997	96732	67573	138473	220527	188549	257929	154359	0.465	0.370	0.584
1998	64801	45571	92147	160426	137489	187189	100630	0.460	0.370	0.572
1999	197387	138542	281225	115023	98676	134079	83195	0.466	0.376	0.578
2000	81630	57442	116002	93447	80046	109092	68944	0.368	0.295	0.460
2001	347092	242808	496166	93381	80977	107685	89640	0.365	0.294	0.453

Year	Recruitment (thousands)			SSB (tonnes)			Catch (tonnes)	F		
	Age 3	2.5 percentile	97.5 percentile	SSB	2.5 percentile	97.5 percentile		Mean F ages 4–7	2.5 percentile	97.5 percentile
2002	355408	250073	505110	107449	94003	122817	114798	0.341	0.275	0.423
2003	246548	174767	347813	139684	122955	158691	138926	0.407	0.332	0.500
2004	220076	162331	298364	159778	141020	181032	158279	0.417	0.337	0.515
2005	353226	256327	486755	174816	154248	198126	158298	0.436	0.355	0.536
2006	163602	120716	221724	172205	152288	194728	153157	0.389	0.316	0.479
2007	879343	619641	1247890	179156	158611	202362	161525	0.355	0.287	0.439
2008	1251215	887076	1764830	198050	174048	225362	155604	0.291	0.231	0.367
2009	1030019	729075	1455185	211140	185777	239966	200061	0.259	0.205	0.328
2010	307787	227558	416303	311541	269914	359588	249200	0.241	0.192	0.304
2011	110337	81686	149038	432296	369456	505825	309785	0.232	0.184	0.292
2012	293014	212566	403908	565427	479604	666606	315627	0.206	0.164	0.260
2013	106180	77825	144866	604134	511426	713648	193744	0.164	0.130	0.207
2014	332329	242707	455043	596585	502251	708638	177522	0.168	0.133	0.212
2015	68172	48383	96056	555089	462004	666931	194756	0.201	0.160	0.252
2016	177353	124838	251960	526338	433025	639760	233183	0.255	0.204	0.320
2017	147786	109072	200240	388448	312924	482200	227588	0.383	0.306	0.479
2018	336138	200367	563908	279971	216450	362133	191276	0.378	0.294	0.487
2019	930100 [^]			220245						

[^] RCT3 estimate.

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