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

ICES stock advice

ICES advises that when the Joint Russian–Norwegian Fisheries Commission management plan is applied, catches in 2018 should be no more than 202 305 tonnes.

Stock development over time

The spawning–stock biomass (SSB) has been above MSY $B_{trigger}$ since 1989. The exceptionally strong year classes of 2004–2006 have contributed to the strong increase in all-time high levels of SSB seen in later years; however, the SSB in 2017 is declining. Fishing mortality has been below F_{MSY} since 2008. Recruitment at age 3 in 2016 was slightly below average.

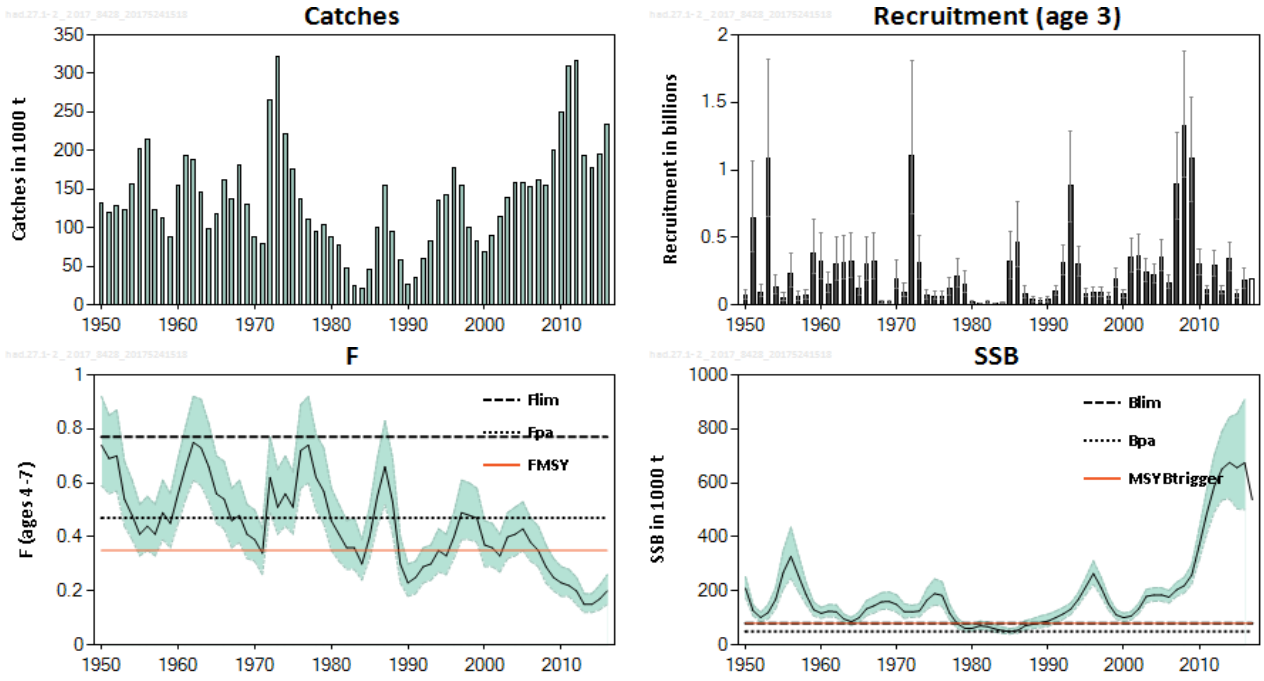

Figure 1 Haddock in subareas 1 and 2. Summary of the stock assessment (weights in thousand tonnes). Recruitment, F, and SSB have confidence intervals (95%) in the plot. For this stock, $F_{MGT} = F_{MSY}$ and SSB_{MGT} = MSY $B_{trigger}$ = B_{pa}; therefore, the horizontal lines representing these points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

Stock and exploitation status

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

		Fishing pressure				Stock size			
		2014	2015	2016		2015	2016	2017	
Maximum Sustainable Yield	F_{MSY}	✓	✓	✓	Below	MSY $B_{Trigger}$	✓	✓	✓ Above trigger
Precautionary Approach	F_{pa}, F_{lim}	✓	✓	✓	Harvested sustainably	B_{pa}, B_{lim}	✓	✓	✓ Full reproductive capacity
Management plan	F_{MGT}	✓	✓	✓	Below	B_{MGT}	✓	✓	✓ Above

Catch options

Table 2 Haddock in subareas 1 and 2. The basis for the catch options.

Variable	Value	Source	Notes
$F_{ages\ 4–7}$ (2017)	0.31	ICES (2017)	TAC constraint F.
SSB (2018)	401 586	ICES (2017)	(in tonnes).
R_{age3} (2017)	193 000	ICES (2017)	RCT3 from multiple surveys (in thousands).
R_{age3} (2018)	386 000	ICES (2017)	RCT3 from multiple surveys (in thousands).
Total catch (2017)	233 000	ICES (2017)	TAC (in tonnes).
Landings (2017)	233 000	ICES (2017)	TAC (in tonnes).
Discards (2017)	0	ICES (2017)	Discarding is considered negligible.

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

Basis	Total catch (2018)	F_{total} (2018)	SSB (2019)	% SSB change *	% TAC change **
ICES advice basis					
Management plan	202 305	0.35	289 378	−28	−13
Other options					
MSY approach: F_{MSY}	202 305	0.35	289 378	−28	−13
F = 0	0	0.0	451 494	12	−100
$F = F_{2017}$	183 247	0.31	303 905	−24	−21
F_{pa}	254 455	0.47	250 568	−38	9
F_{lim}	357 965	0.77	178 560	−56	54

* SSB 2019 relative to SSB 2018.

** Catch in 2018 relative to TAC in 2017 (233 000 t).

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, 14 October 2011): – *TAC for the next year will be set at level corresponding to FMSY.* – *The TAC should not be changed by more than ±25% compared with the previous year TAC.* – *If the spawning stock falls below Bpa, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from FMSY at Bpa to F= 0 at SSB equal to zero. At SSB-levels below Bpa 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.* 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, 2016a) and concluded that it is precautionary.

Quality of the assessment

The main source of uncertainty in the assessment this year is incomplete survey coverage and absence of one survey last year.

The sampling level from commercial catches was reduced around year 2010 and has remained at a lower level since then. Insufficient sampling of commercial catches is impairing the quality of the assessment and the advice.

Discarding is known to have taken place, but discards cannot be quantified (assumed to be below 5% in recent years).

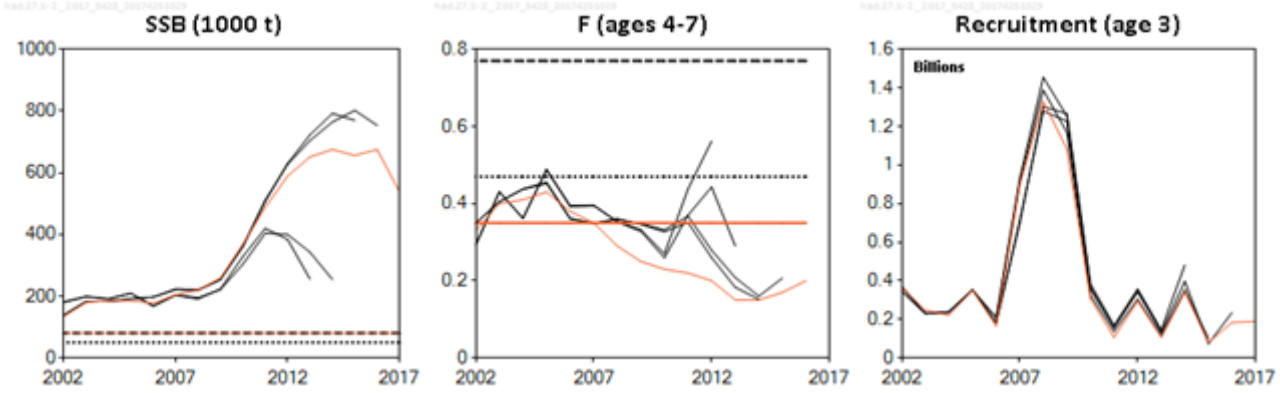

Figure 2 Haddock in subareas 1 and 2. Historical assessment results. For the 2015 and 2016 assessments, the fishing mortality plot shows F+M2 (natural mortality due to predation by cod), instead of only F.

Issues relevant for the advice

The advice for 2018 is based on the assumption that catches in 2017 are equal to the TAC (233 000 tonnes), but fishing opportunities for 2016 (TAC plus transfers from 2015) were not fully taken. Parties have transferred the unused part (about 30 000 t) of their haddock quotas in 2016 to 2017, so the out-take in 2017 could be higher than the TAC, although catches equal to the TAC are considered to be more likely.

The biomass of age 10 and older fish in recent years has been extremely high, well outside the range previously experienced. Thus, survey results for these ages are difficult to relate to previous observations, which is likely to generate some instabilities in the assessment results. Despite the potential for instability and relatively large revisions in historical SSB estimates in the coming years, it is expected that current stock status is unlikely to be affected.

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 t	B_{pa}.	ICES (2011)
	F_{MSY}	0.35	Stochastic long-term simulations.	ICES (2011)
Precautionary approach	B_{lim}	50 000 t	B_{loss}.	ICES (2011)
	B_{pa}	80 000 t	$B_{lim} \times \exp(1.645 \times 0.3)$.	ICES (2011)
	F_{lim}	0.77	Corresponds to the SPR value of the slope of the line leading from SSB = 0 to the geometric mean recruitment at SSB = B_{lim}.	ICES (2011)
	F_{pa}	0.47	$F_{lim} \times \exp(-1.645 \times 0.3)$.	ICES (2011)
Management plan	SSB_{MGT}	80 000 t	B_{pa}. TAC is linearly reduced from F_{pa} at SSB = B_{pa} to zero at SSB = 0.	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, 2016b).
Assessment type	Age-based analytical assessment (SAM; ICES, 2017) that uses landings 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 available from 1984.
Discards and bycatch	Discarding is considered negligible in recent years (below 5%). Bycatch is included.
Indicators	None.
Other information	Last benchmarked in January 2015 (WKARCT; ICES, 2015a). Implementation of predation by cod on haddock in SAM has been changed since 2016.
Working group	Arctic Fisheries Working Group (AFWG)

Information from stakeholders

No information was provided.

History of the advice, catch, and management

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

Year	ICES advice	Predicted catch corresp. to advice	Agreed TAC	Official landings*	Unreported landings (included in ICES 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	5828	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	233 416
2017	Apply management plan	≤ 233 000	233 000			
2018	Apply management plan	≤ 202 305				

* Haddock in Norwegian statistical areas 06 and 07 are included.
** Unreported landings in 2002–2008 are included.
*** Predicted landings at F_{med}.
^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 t to 223 000 t).

History of the catch and landings

Table 8 Haddock in subareas 1 and 2. Catch distribution by fleet in 2016 as estimated by ICES.

Catch (2016)	Landings			Discards
233 416 tonnes	trawls 70%	longline 15%	other gears 15%	Unknown, but assumed to be negligible
	233 416 tonnes			

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Table 9 Haddock in subareas 1 and 2. History of commercial catch and landings. 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	-	-	5597		46 263	-	57 025		45 469	125	-	154 651
1961	285	220	-	6304		60 862	-	85 345		39 650	558	-	193 224
1962	83	409	-	2895		54 567	-	91 910		37 486	58	-	187 408
1963	17	363	-	2554		59 955	-	63 526		19 809	-	-	146 224
1964	-	208	-	1482		38 695	-	43 870		14 653	250	-	99 158
1965	-	226	-	1568		60 447	-	41 750		14 345	242	-	118 578
1966	-	1072	11	2098		82 090	-	48 710		27 723	74	-	161 778
1967	-	1208	3	1705		51 954	-	57 346		24 158	23	-	136 397
1968	-	-	-	1867		64 076	-	75 654		40 129	-	-	181 726
1969	2	-	309	1490		67 549	-	24 211		37 234	25	-	130 820
1970	541	-	656	2119		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	1433		46 700	1433	196 224		17 166	2231	-	266 153
1973	1212	3214	22	9534		86 767	34	186 534		32 408	2501	-	322 226
1974	925	3601	454	23 409		66 164	3045	78 548		37 663	7348	-	221 157
1975	299	5191	437	15 930		55 966	1080	65 015		28 677	3163	-	175 758
1976	536	4459	348	16 660		49 492	986	42 485		16 940	5358	-	137 264
1977	213	1510	144	4798		40 118	-	52 210		10 878	287	-	110 158
1978	466	1411	369	1521		39 955	1	45 895		5766	38	-	95 422
1979	343	1198	10	1948		66 849	2	26 365		6454	454	-	103 623
1980	497	226	15	1365		66 501	-	20 706		2948	246	-	92 504
1981	381	414	22	2402		63 435		13 400		1682	-	-	81 736
1982	496	53	-	1258		43 702		2900	-	827	-	-	49 236
1983	428	-	1	729		22 364		680	139	259	-	-	24 600
1984	297	15	4	400		18 813		1103	37	276	-	-	20 945
1985	424	21	20	395		21 272		22 690	77	153	-	-	45 052
1986	893	12	75	1079		52 313		45 738	22	431	-	-	100 563
1987	464	7	83	3105		72 419		78 211	59	563	5	-	154 916
1988	1113	116	78	1323		60 823		31 293	72	435	2	-	95 255
1989	1217	-	26	171		36 451		20 062	1	590	-	-	58 518
1990	705	-	5	167		20 621		5190	-	494	-	-	27 182
1991	1117	-		213		22 178		12 177	-	514	17	-	36 216
1992	1093	151		387	1719	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	1215		1165	880	40 978		35 071	76	1802	646	-	82 379
1994	2761	678		2412	770	71 171		51 822	22	4673	877	-	135 186
1995	2833	598		2675	1097	76 886		54 516	14	3111	718	-	142 448
1996	3743	6		942	1510	94 527		74 239	669	2275	217	-	178 128
1997	3327	540		972	1877	103 407		41 228	364	2340	304	-	154 359
1998	1903	241		385	854	75 108		20 559	257	1229	94	-	100 630
1999	1913	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	1210	324		554	553	49 067		34 307	1497	1068	1060	-	89 640
2002	1564	297		627	858	52 247		37 157	1505	1125	682	18 736	114 798
2003	1959	382		918	1363	56 485		41 142	1330	1018	1103	33 226	138 926
2004	2484	103		823	1680	62 192		54 347	54	1250	1569	33 777	158 279
2005	2138	333		996	15	60 850		50 012	963	1899	1262	40 283	158 751
2006	2390	883		989	1830	69 272		53 313	703	1164	1162	21 451	153 157
2007	2307	277		1123	1464	71 244		66 569	125	1351	2511	14 553	161 525
2008	2687	311		535	1659	72 779		68 792	283	971	1759	5828	155 604
2009	2820	529		1957	1410	104 354		85 514	317	1315	1845	0	200 061
2010	3173	764		3539	1970	123 384		111 372	379	1758	2862	0	249 200
2011	1759	268		1724	2110	158 202		139 912	502	1379	4763	0	309 785
2012	2055	322		1111	3984	159 602		143 886	441	833	3393	0	315 627
2013	1886	342		500	1795	99 215		85 668	439	639	3260	0	193 744
2014	1470	198		340	1150	91 306		78 725	187	355	3791	0	177 522
2015	2459	145		124	1047	95 094		91 864	246	450	3327	0	194 756
2016*	2460	340		170	1401	108 718		115 710	200	575	3838	0	233 416

*Provisional figures.
** USSR prior to 1991.
*** Figures based on Norwegian/Russian IUU estimates.
^ Landings in Norwegian statistical areas 06 and 07 (from 1983) are included.

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Summary of the assessment

Table 10 Haddock in subareas 1 and 2. Assessment summary. Weights are in tonnes. Highs and lows are 95% confidence intervals.

Year	Recruitment Age 3	High	Low	SSB	High	Low	Landings	F at ages 4–7	High	Low
	thousands			tonnes			tonnes	year −1		
1950	69 139	116 303	41 101	209 943	252 685	174 431	132 125	0.74	0.92	0.59
1951	644 460	1 070 241	388 070	126 789	148 712	108 097	120 077	0.69	0.85	0.56
1952	94 298	156 427	56 845	101 855	120 368	86 190	127 660	0.7	0.87	0.57
1953	1089 462	1 817 378	653 099	120 005	150 182	95 891	123 920	0.54	0.68	0.44
1954	134 997	224847	81 052	169 415	213 237	134 600	156 788	0.48	0.61	0.39
1955	55 903	93 877	33 290	269 329	350 216	207 124	202 286	0.41	0.52	0.33
1956	229 037	384 485	136 437	327 556	435 198	246 539	213 924	0.44	0.55	0.35
1957	59 373	98 855	35 660	256 400	332 951	197 450	123 583	0.41	0.52	0.33
1958	68 083	114 254	40 570	186 736	231 797	150 435	112 672	0.49	0.61	0.39
1959	384 308	634 161	232 894	130 789	158 869	107 673	88 211	0.45	0.56	0.36
1960	322 474	533 901	194 773	117 263	139 062	98 881	154 651	0.56	0.69	0.45
1961	148 830	244 208	90 703	125 148	149 222	104 957	193 224	0.66	0.81	0.54
1962	305 263	499 910	186 404	122 920	148 535	101 722	187 408	0.75	0.92	0.61
1963	312 159	511 202	190 616	96 457	114 441	81 299	146 224	0.73	0.91	0.59
1964	326 481	537 707	198 230	86 438	102 128	73 159	99 158	0.66	0.82	0.53
1965	125 969	207 849	76 345	100 398	121 255	83 128	118 578	0.56	0.7	0.45
1966	305 967	505 190	185 308	133 685	164 040	108 946	161 778	0.54	0.68	0.43
1967	318 932	528 409	192 498	145 200	178 132	118 355	136 397	0.46	0.58	0.36
1968	16 620	27 810	9932	159 840	193 492	132 042	181 726	0.48	0.61	0.38
1969	20 637	34 158	12 468	160 836	196 196	131 848	130 820	0.41	0.52	0.32
1970	196 985	328 815	118 009	149 677	185 282	120 915	88 257	0.39	0.5	0.31
1971	95 942	161 201	57 102	122 792	152 222	99 052	78 905	0.34	0.43	0.26
1972	1104 475	1 810 749	673 680	122 401	146 786	102 068	266 153	0.62	0.77	0.49
1973	315 862	517 237	192 888	125 698	151 818	104 072	322 226	0.51	0.65	0.41
1974	70 631	115 138	43 328	166 497	209 248	132 481	221 157	0.56	0.7	0.44
1975	60 251	97 977	37 051	190 369	244 437	148 261	175 758	0.51	0.64	0.41
1976	63 906	104 461	39 096	183 273	234 010	143 536	137 264	0.72	0.89	0.58
1977	121 998	201 618	73 820	117 033	148 340	92 333	110 158	0.74	0.92	0.6
1978	211 641	346 156	129 399	78 743	99 811	62 123	95 422	0.62	0.78	0.5
1979	153 353	251 638	93 457	61 859	77 502	49 373	103 623	0.57	0.73	0.45
1980	19 647	33 393	11 559	62 008	76 237	50 435	87 889	0.46	0.58	0.35
1981	9475	15 824	5673	71 050	88 079	57 313	77 153	0.41	0.52	0.31
1982	16 570	27 467	9996	67 915	85 516	53 936	46 955	0.36	0.46	0.28
1983	9553	15 980	5711	59 370	74 309	47 433	24 600	0.36	0.47	0.28
1984	14 128	23 522	8486	53 097	66 406	42 456	20 945	0.3	0.39	0.24
1985	326 349	540 778	196 945	49 702	60 889	40 571	45 052	0.4	0.51	0.32
1986	463 304	763 929	280 982	53 934	65 576	44 359	100 563	0.55	0.69	0.44
1987	84 067	139 934	50 504	71 203	90 292	56 150	154 916	0.66	0.83	0.52
1988	38 432	64 600	22 864	76 765	97 487	60 447	95 255	0.53	0.69	0.41
1989	30 395	50 588	18 262	82 916	107 441	63 988	58 518	0.3	0.4	0.23
1990	37 246	59 603	23 275	88 561	113 895	68 862	27 182	0.23	0.3	0.18
1991	98 851	141 432	69 090	100 710	124 995	81 142	36 216	0.25	0.31	0.19
1992	312 410	443 743	219 947	114 864	138 471	95 282	59 922	0.29	0.36	0.23

Year	Recruitment Age 3	High	Low	SSB	High	Low	Landings	F at ages 4–7	High	Low
	thousands			tonnes			tonnes	year −1		
1993	889 656	1 285 454	615 726	132 379	155 193	112 919	82 379	0.3	0.37	0.24
1994	303 493	430 896	213 759	168 189	193 282	146 353	135 186	0.35	0.43	0.27
1995	82 247	117 231	57 703	215 789	250 025	186 241	142 448	0.33	0.41	0.26
1996	92 777	132 007	65 205	264 686	311 274	225 071	178 128	0.4	0.49	0.32
1997	91 932	130 675	64 675	213 340	251 445	181 009	154 359	0.49	0.61	0.39
1998	61 648	87 333	43 517	152 132	178 927	129 350	100 630	0.48	0.6	0.39
1999	192 031	272 460	135 345	111 677	130 749	95 387	83 195	0.47	0.58	0.38
2000	77 633	109 918	54 831	101 294	117 929	87 007	68 944	0.37	0.46	0.29
2001	349 741	497 354	245 939	107 078	123 904	92 536	89 640	0.36	0.45	0.29
2002	367 029	519 439	259 338	134 151	154 015	116 849	114 798	0.33	0.41	0.27
2003	246 621	346 498	175 533	179 813	206 132	156 855	138 926	0.4	0.49	0.32
2004	222 091	302 110	163 266	185 071	211 625	161 849	158 279	0.41	0.51	0.33
2005	350 823	484 365	254 099	185 096	211 460	162 020	158 298	0.43	0.53	0.35
2006	164 974	224 221	121 382	177 148	202 198	155 201	153 157	0.38	0.47	0.31
2007	898 282	1273 730	633 503	204 372	232 242	179 846	161 525	0.35	0.44	0.29
2008	1 329 769	1880 857	940 149	219 350	250 247	192 268	155 604	0.29	0.37	0.23
2009	1 083 394	1533 178	765 562	258 731	297 324	225 147	200 061	0.25	0.32	0.2
2010	307 270	417 003	226 413	368 654	430 238	315 885	249 200	0.23	0.29	0.18
2011	106 895	144 999	78 804	487 852	576 485	412 847	309 785	0.22	0.28	0.18
2012	294 197	406 370	212 988	588 932	704 017	492 660	315 627	0.2	0.25	0.15
2013	105 011	143 995	76 581	651 494	790 398	537 000	193 744	0.15	0.19	0.12
2014	340 143	467 328	247 571	675 563	843 617	540 987	177 522	0.15	0.19	0.12
2015	79 170	111 928	55 999	656 269	855 419	503 483	194 756	0.17	0.22	0.13
2016	183 956	269 123	125 741	675 068	909 423	501 105	233 416	0.2	0.26	0.15
2017	193 000^			537 865						
Average	**254 377**			**192 198**			**138 726**	**0.441**		

^ RCT3 estimate.

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