

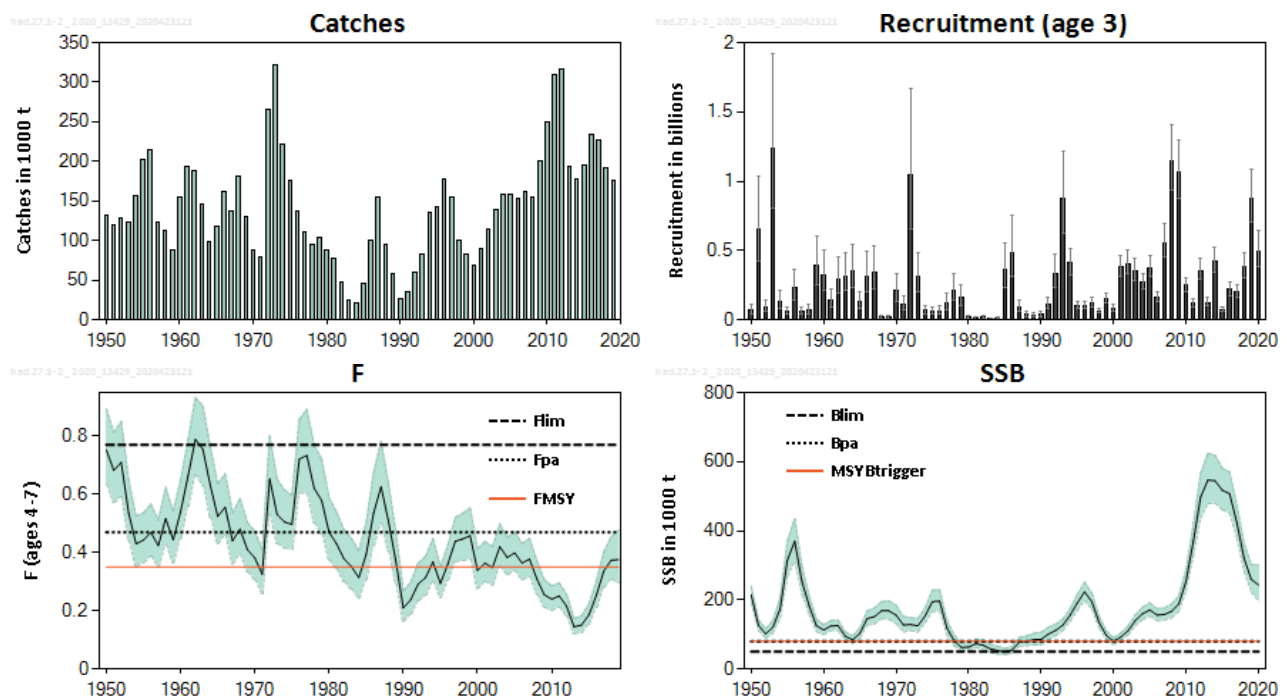
## Haddock (*Melanogrammus aeglefinus*) in subareas 1 and 2 (Northeast Arctic)

### ICES advice on fishing opportunities

ICES advises that when the Joint Norwegian–Russian Fisheries Commission management plan is applied, catches in 2021 should be no more than 232 537 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 and afterwards began to decrease; however, it is still well above  $MSY B_{trigger}$ . Recruitment in 2019 is among the highest. Fishing mortality (F) has increased since 2013 and was above  $F_{MSY}$  in 2019.



**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 the fishery relative to reference points.

	Fishing pressure			Stock size						
	2017	2018	2019	2018	2019	2020				
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 (R) is in thousands and weights are in tonnes.

Variable	Value	Notes
$F_{ages\ 4-7}$ (2020)	0.37	TAC constraint
SSB (2021)	249570	Based on TAC constraint
$R_{age\ 3}$ (2020)	497416	SAM estimates
$R_{age\ 3}$ (2021)	293623	RCT3 estimates
$R_{age\ 3}$ (2022)	38636	RCT3 estimates
Total catch (2020)	215000	TAC set by the 49th JNRFC *

\* Joint Norwegian–Russian Fisheries Commission.

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

Basis	Total catch (2021)	F ages 4–7 (2021)	SSB (2022)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan	232537	0.35	272210	9.1	8.2	8.2
Other scenarios						
MSY approach: $F_{MSY}$	232537	0.35	272210	9.1	8.2	8.2
$F = 0$	0	0	394626	58.1	-100	-100
$F = F_{2020}$	245410	0.37	265779	6.5	14.1	14.1
$F_{pa}$	296269	0.47	240780	-3.5	38	38
$F_{lim}$	428689	0.77	179103	-28.2	99	99

\* SSB 2022 relative to SSB 2021.

\*\* Catch in 2021 relative to TAC in 2020 (215 000 tonnes).

\*\*\* Catch value for 2021 relative to the advice value for 2020 (215 000 tonnes).

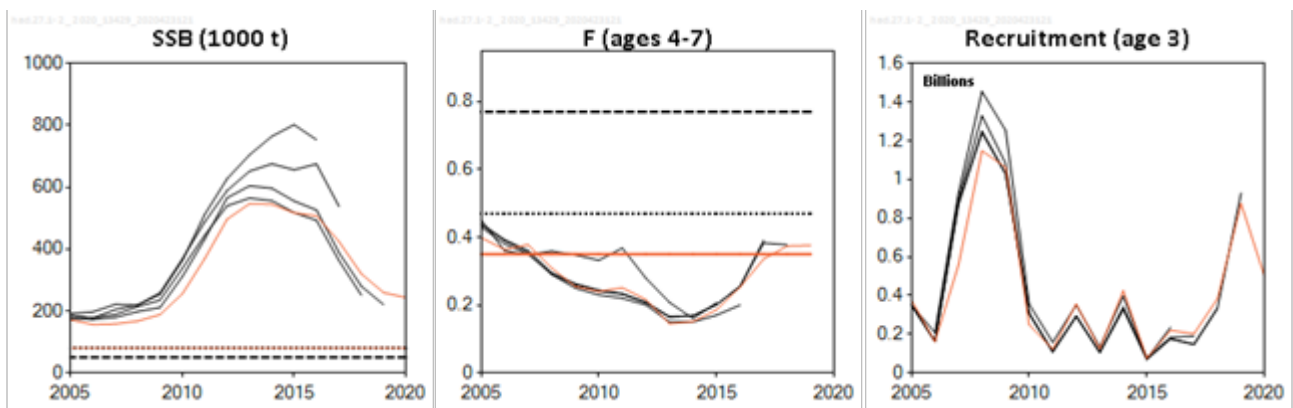
**Basis of the advice**

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

Advice basis	Joint Norwegian–Russian Fisheries Commission management plan
Management plan	<p>The current HCR for haddock is as follows (see details in Protocol of the 46<sup>th</sup> Session of the Joint Norwegian–Russian Fisheries Commission – JNRFC, 2016):</p> <p><i>TAC for the next year will be set at level corresponding to FMSY.</i></p> <p><i>The TAC should not be changed by more than ±25% compared with the previous year TAC.</i></p> <p><i>If the spawning stock falls below <math>B_{pa}</math>, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from FMSY at <math>B_{pa}</math> to <math>F = 0</math> at SSB equal to zero. At SSB-levels below <math>B_{pa}</math> 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></p> <p>At the 46th Session of the Joint Norwegian–Russian Fisheries Commission in 2016 it was decided to keep the existing HCR for haddock for the next five years.</p> <p>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.</p> <p>ICES evaluated this HCR in 2016 (ICES, 2016) and rechecked it in 2020 (ICES, 2020a). ICES concluded that the HCR is precautionary.</p>

**Quality of the assessment**

The assessment from the current year is consistent with the assessment carried out at the latest benchmark (ICES, 2020a). The retrospective pattern in SSB in previous years had raised concerns about the reliability of the assessment. The model settings and data were changed during the benchmark. The changes, especially the extension of the age range by including a plus group in the survey-tuning series, improved the retrospective bias (ICES, 2020a, 2020b). The benchmark did not result in changes to the reference points values.



**Figure 2** Haddock in subareas 1 and 2. Historical assessment results. For the 2016 assessment, the fishing mortality plot shows  $F + M_2$  (natural mortality due to predation by cod), instead of only  $F$ . The stock was benchmarked in 2020 (ICES, 2020a).

**Issues relevant for the advice**

As the strong 2016 and 2017 cohorts enter the fisheries there is a likelihood of higher catch of undersized fish in the coming year(s). It is therefore important that the fishery is regulated additionally by spatial and temporal closures, as this will reduce the likelihood of high catch and possible discarding of undersized fish from the abundant 2016 and 2017 year classes. The 2018 and 2019 year classes are estimated as below average of the year classes 1990–2017.

## 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 $B_{trigger}$	80000 tonnes	$B_{pa}$ .	ICES (2020a)
	$F_{MSY}$	0.35	Stochastic long-term simulations.	ICES (2020a)
Precautionary approach	$B_{lim}$	50000 tonnes	$B_{loss}$ .	ICES (2020a)
	$B_{pa}$	80000 tonnes	$B_{lim} \times \exp(1.645 \times \sigma)$ , where $\sigma = 0.3$ .	ICES (2020a)
	$F_{lim}$	0.77	Determined from replacement line leading from $SSB = 0$ to the geometric mean recruitment at $SSB = B_{lim}$ .	ICES (2020a)
	$F_{pa}$	0.47	$F_{lim} \times \exp(-1.645 \times \sigma)$ , where $\sigma = 0.3$ .	ICES (2020a)
Management plan	$SSB_{MGT}$	80000 tonnes	$B_{pa}$ .	ICES (2020a)
	$F_{MGT}$	0.35	$F_{MSY}$ .	ICES (2020a)

## Basis of the assessment

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

ICES stock data category	1 ( <a href="#">ICES, 2019</a> ).
Assessment type	Age-based analytical assessment (SAM) that uses catches in the model.
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 and stock weight-at-age data from surveys; from 1984, the natural mortalities are derived from the consumption of haddock (ages 3–6) by cod..
Discards and bycatch	Discarding is considered negligible in recent years.
Indicators	None.
Other information	Last benchmarked in February 2020 (ICES, 2020a).
Working group	Arctic Fisheries Working Group ( <a href="#">AFWG</a> ).

## 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, TAC, and the 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	160000	250000	154916		154916
1988	No increase in F	< 240000	240000	95255		95255
1989	Large reduction in F	69000	83000	58518		58518
1990	No directed fishery	-	25000	27182		27182
1991	No directed fishery	-	28000	36216		36216
1992	Within safe biological limits	35000	63000	59922		59922
1993	No long-term gains in increasing F	56000	72000	82379		82379
1994	No long-term gains in $F > F_{med}$	97000**	120000	135186		135186
1995	No long-term gains in $F > F_{med}$	122000**	130000	142448		142448
1996	No long-term gains in $F > F_{med}$	169000**	170000	178128		178128
1997	Well below $F_{med}$	< 242000	210000	154359		154359
1998	Below $F_{med}$	< 120000	130000	100630		100630
1999	Reduce F below $F_{pa}$	< 74000	78000	83195		83195
2000	Reduce F below $F_{pa}$	< 37000	62000	68944		68944
2001	Reduce F below $F_{pa}$	< 66000	85000	89640		89640
2002	Reduce F below $F_{pa}$	< 64000	85000	96062	18736	114798
2003	Reduce F below $F_{pa}$	< 101000	101000	105700	33226	138926
2004	Reduce F below $F_{pa}$	< 120000	130000	124502	33777	158279

Year	ICES advice	Catch corresponding to advice	Agreed TAC	Official landings*	Unreported landings	ICES landings
2005	Reduce F below $F_{pa}$	< 106000	117000	118015	40283	158298
2006	Reduce F below $F_{pa}$	< 112000	120000	131706	21451	153157
2007	Limit catches	< 130000	150000	146972	14553	161525
2008	Limit catches to 2001–2004 average	< 130000	155000	149776	5828	155604
2009	Apply management plan	< 194000	194000	200061	0	200061
2010	Apply management plan	< 243000	243000	249200	0	249200
2011	Apply management plan	< 303000	303000	309785	0	309785
2012	Apply management plan	< 318000	318000	315627	0	315627
2013	Apply management plan	< 238000	200000	193744	0	193744
2014	Apply management plan	< 150000	178500	177522	0	177522
2015	Apply management plan	< 165000	223000	194756	0	194756
2016	Apply management plan	< 244000 <sup>^</sup>	244000	233416	0	233183
2017	Apply management plan	≤ 233000	233000	227588	0	227588
2018	Apply management plan	≤ 202305	202305	191276	0	191276
2019	Apply management plan	≤ 152000	172000	175402	0	175402
2020	Apply management plan	≤ 215000	215000			
2021	Apply management plan	≤ 232537				

<sup>^</sup> This advice was updated on 7 July 2015, in response to a special request (ICES, 2015) after a mid-year change in TAC in 2015 (from 178500 tonnes to 223000 tonnes).

\* Coastal haddock in Norwegian statistical areas 06 and 07 (south of Lofoten) 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 2019, as estimated by ICES.

Catch (2019)	Landings			Discards
	trawls 66%	longline 22%	other gears 12%	
175402 tonnes	175402 tonnes			Discarding is unknown, but assumed to be negligible

**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	-	-	5597		46263	-	57025		45469	125	-	154651
1961	285	220	-	6304		60862	-	85345		39650	558	-	193224
1962	83	409	-	2895		54567	-	91910		37486	58	-	187408
1963	17	363	-	2554		59955	-	63526		19809	-	-	146224
1964	-	208	-	1482		38695	-	43870		14653	250	-	99158
1965	-	226	-	1568		60447	-	41750		14345	242	-	118578
1966	-	1072	11	2098		82090	-	48710		27723	74	-	161778
1967	-	1208	3	1705		51954	-	57346		24158	23	-	136397
1968	-	-	-	1867		64076	-	75654		40129	-	-	181726
1969	2	-	309	1490		67549	-	24211		37234	25	-	130820
1970	541	-	656	2119		37716	-	26802		20423	-	-	88257
1971	81	-	16	896		45715	43	15778		16373	3	-	78905
1972	137	-	829	1433		46700	1433	196224		17166	2231	-	266153
1973	1212	3214	22	9534		86767	34	186534		32408	2501	-	322226
1974	925	3601	454	23409		66164	3045	78548		37663	7348	-	221157
1975	299	5191	437	15930		55966	1080	65015		28677	3163	-	175758
1976	536	4459	348	16660		49492	986	42485		16940	5358	-	137264
1977	213	1510	144	4798		40118	-	52210		10878	287	-	110158
1978	466	1411	369	1521		39955	1	45895		5766	38	-	95422
1979	343	1198	10	1948		66849	2	26365		6454	454	-	103623
1980	497	226	15	1365		66501	-	20706		2948	246	-	92504
1981	381	414	22	2402		63435		13400		1682	-	-	81736
1982	496	53	-	1258		43702		2900	-	827	-	-	49236
1983	428	-	1	729		22364		680	139	259	-	-	24600
1984	297	15	4	400		18813		1103	37	276	-	-	20945
1985	424	21	20	395		21272		22690	77	153	-	-	45052
1986	893	12	75	1079		52313		45738	22	431	-	-	100563
1987	464	7	83	3105		72419		78211	59	563	5	-	154916
1988	1113	116	78	1323		60823		31293	72	435	2	-	95255
1989	1217	-	26	171		36451		20062	1	590	-	-	58518
1990	705	-	5	167		20621		5190	-	494	-	-	27182
1991	1117	-		213		22178		12177	-	514	17	-	36216

Year	Faroe Islands	France	German Dem. Rep.	Fed. Rep. Germ.	Greenland	Norway^	Poland	Russia**	Spain	United Kingdom	Others	Unreported catches***	Total
1992	1093	151		387	1719	36238		19699	38	596	1	-	59922
1993	546	1215		1165	880	40978		35071	76	1802	646	-	82379
1994	2761	678		2412	770	71171		51822	22	4673	877	-	135186
1995	2833	598		2675	1097	76886		54516	14	3111	718	-	142448
1996	3743	6		942	1510	94527		74239	669	2275	217	-	178128
1997	3327	540		972	1877	103407		41228	364	2340	304	-	154359
1998	1903	241		385	854	75108		20559	257	1229	94	-	100630
1999	1913	64		641	437	48182		30520	652	694	92	-	83195
2000	631	178		880	432	42009		22738	502	747	827	-	68944
2001	1210	324		554	553	49067		34307	1497	1068	1060	-	89640
2002	1564	297		627	858	52247		37157	1505	1125	682	18736	114798
2003	1959	382		918	1363	56485		41142	1330	1018	1103	33226	138926
2004	2484	103		823	1680	62192		54347	54	1250	1569	33777	158279
2005	2138	333		996	15	60850		50012	963	1899	1262	40283	158751
2006	2390	883		989	1830	69272		53313	703	1164	1162	21451	153157
2007	2307	277		1123	1464	71244		66569	125	1351	2511	14553	161525
2008	2687	311		535	1659	72779		68792	283	971	1759	5828	155604
2009	2820	529		1957	1410	104354		85514	317	1315	1845	0	200061
2010	3173	764		3539	1970	123384		111372	379	1758	2862	0	249200
2011	1759	268		1724	2110	158202		139912	502	1379	4763	0	309785
2012	2055	322		1111	3984	159602		143886	441	833	3393	0	315627
2013	1886	342		500	1795	99215		85668	439	639	3260	0	193744
2014	1470	198		340	1150	91306		78725	187	355	3791	0	177522
2015	2459	145		124	1047	95094		91864	246	450	3327	0	194756
2016	2460	340		170	1401	108718		115710	200	575	3838	0	233416
2017	2776	108		170	1810	113132		106714	228	372	2279	0	227588
2018	2333	183		385	1317	93839		90486	169	453	2173	0	191276
2019*	1515	143		204	1208	93860		76125	280	456	1611	0	175402

\* Provisional figures.

\*\* USSR prior to 1991.

\*\*\* Figures based on Norwegian/Russian illegal, unreported, and unregulated fisheries (IUU) estimates.

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

**Table 10** Haddock in subareas 1 and 2. Catches inside and outside the NEAFC Regulatory Area (RA) as estimated by ICES.

Year	Inside the NEAFC RA (tonnes)	Outside the NEAFC RA (tonnes)	Total catches (tonnes)	Proportion inside the NEAFC RA (%)
2017	90	227498	227588	< 0.01%
2018	24	191252	191276	0.013%
2019	394	175008	175402	0.23%

### Summary of the assessment

**Table 11** Haddock in subareas 1 and 2. Assessment summary. High and low represent 95% confidence limits.

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	72765	45993	115120	214657	192015	239968	132125	0.75	0.63	0.89
1951	657821	418643	1033644	126320	112029	142434	120077	0.68	0.57	0.81
1952	89596	56731	141501	101702	88528	116836	127660	0.71	0.59	0.85
1953	1239918	801946	1917083	120740	103933	140266	123920	0.54	0.44	0.65
1954	134460	85206	212187	174445	147108	206864	156788	0.43	0.35	0.53
1955	58888	36937	93883	314997	267616	370767	202286	0.44	0.37	0.54
1956	231056	146096	365425	369541	313644	435399	213924	0.47	0.39	0.57
1957	60568	38153	96153	253899	216986	297092	123583	0.42	0.35	0.51
1958	73117	46330	115390	182231	157966	210224	112672	0.52	0.43	0.62
1959	391038	253665	602806	125313	108538	144680	88211	0.44	0.37	0.54
1960	323444	208742	501174	112797	99260	128179	154651	0.54	0.45	0.65
1961	146436	94828	226130	124952	111084	140551	193224	0.66	0.56	0.79
1962	296047	192049	456361	125437	111265	141415	187408	0.79	0.67	0.93
1963	317406	207377	485815	94457	82963	107544	146224	0.76	0.63	0.90
1964	355853	231180	547763	84600	74142	96534	99158	0.63	0.52	0.76
1965	127776	81986	199141	103209	89784	118642	118578	0.52	0.43	0.64
1966	315718	203789	489123	146049	126751	168286	161778	0.56	0.46	0.67
1967	342444	220270	532380	151400	130057	176245	136397	0.44	0.36	0.54
1968	18020	11063	29351	168447	145349	195215	181726	0.48	0.40	0.59
1969	20779	12870	33549	168230	143981	196563	130820	0.41	0.33	0.50
1970	211495	135036	331245	155651	131527	184199	88257	0.38	0.31	0.47
1971	110588	69914	174927	127727	107269	152088	78905	0.33	0.26	0.41
1972	1048060	658218	1668794	128660	111456	148520	266153	0.65	0.53	0.80
1973	312636	202372	482978	124977	106936	146061	322226	0.53	0.43	0.65
1974	66576	42831	103487	153559	133455	176692	221157	0.51	0.42	0.62
1975	59783	38456	92938	194787	166283	228178	175758	0.50	0.41	0.60
1976	62392	39554	98416	196521	168413	229320	137264	0.72	0.61	0.86
1977	121398	76071	193733	118741	99835	141228	110158	0.73	0.60	0.89
1978	215993	140029	333165	81314	67122	98508	95422	0.62	0.50	0.77
1979	162376	105052	250980	62698	52610	74721	103623	0.58	0.47	0.72
1980	22032	13487	35993	63105	53417	74551	87889	0.47	0.38	0.59
1981	10230	6043	17318	73239	61677	86967	77153	0.43	0.34	0.54
1982	16883	10332	27587	68902	56749	83657	46955	0.38	0.30	0.48
1983	8795	5165	14974	58318	47705	71291	24600	0.35	0.28	0.45
1984	13327	8158	21771	53231	43213	65571	20945	0.31	0.24	0.41
1985	358965	231533	556533	49235	40836	59363	45052	0.39	0.31	0.50
1986	486470	314406	752699	55064	46501	65205	100563	0.54	0.42	0.68
1987	90234	57394	141865	78142	66567	91730	154916	0.63	0.50	0.78
1988	38764	24122	62293	80270	67278	95772	95255	0.51	0.41	0.64
1989	29093	17939	47182	84794	69520	103423	58518	0.37	0.29	0.47
1990	38095	24272	59788	85992	69607	106234	27182	0.21	0.164	0.27
1991	112770	78840	161301	100964	84393	120790	36216	0.24	0.189	0.30
1992	335839	237002	475895	111689	96175	129705	59922	0.29	0.24	0.36
1993	871351	625838	1213178	126952	111529	144507	82379	0.31	0.25	0.39
1994	408416	327301	509634	155819	138690	175064	135186	0.37	0.30	0.45



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
1995	102594	79526	132352	191555	169940	215920	142448	0.29	0.25	0.35
1996	101731	79190	130688	223524	198460	251755	178128	0.36	0.31	0.43
1997	122399	95439	156974	194677	172844	219266	154359	0.44	0.37	0.52
1998	65113	50035	84733	134694	118864	152631	100630	0.45	0.37	0.54
1999	155882	124082	195832	97103	85722	109995	83195	0.46	0.38	0.55
2000	85278	66389	109540	79831	70369	90566	68944	0.34	0.28	0.41
2001	378004	307448	464752	92654	82379	104211	89640	0.36	0.30	0.44
2002	407536	330699	502227	110733	98489	124499	114798	0.35	0.29	0.42
2003	351769	281167	440099	140388	125583	156938	138926	0.42	0.35	0.50
2004	268081	217849	329896	159937	143007	178871	158279	0.38	0.32	0.45
2005	377498	308112	462510	171108	153062	191282	158298	0.40	0.34	0.47
2006	161291	129781	200452	155919	139309	174511	153157	0.36	0.31	0.43
2007	557313	450582	689328	157825	141192	176416	161525	0.38	0.32	0.45
2008	1148507	938634	1405307	167069	148208	188331	155604	0.31	0.26	0.37
2009	1063274	872984	1295042	187975	166808	211827	200061	0.26	0.21	0.31
2010	248645	201139	307370	255386	226372	288119	249200	0.24	0.20	0.29
2011	122124	96149	155117	368859	326583	416607	309785	0.25	0.21	0.30
2012	355908	288429	439175	496499	436152	565197	315627	0.22	0.182	0.26
2013	124281	98323	157091	546646	478736	624190	193744	0.145	0.121	0.174
2014	424667	345604	521818	544815	480199	618127	177522	0.151	0.126	0.183
2015	74893	58233	96319	516995	460419	580522	194756	0.186	0.155	0.22
2016	219046	175116	273996	507532	451563	570437	233183	0.25	0.21	0.30
2017	202078	161953	252145	424640	379553	475083	227588	0.34	0.28	0.40
2018	383993	306983	480320	320136	281963	363476	191276	0.37	0.31	0.45
2019	875345	705907	1085453	259244	222378	302222	175402	0.38	0.30	0.48
2020	497416	386918	639470	243132	196489	300848				

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