

Saithe (*Pollachius virens*) in subareas 1 and 2 (Northeast Arctic)

ICES advice on fishing opportunities

ICES advises that when the Norwegian management plan is applied, catches in 2020 should be no more than 171 982 tonnes.

Stock development over time

The spawning-stock biomass (SSB) has been above B_{pa} since 1996, and is presently estimated to be well above B_{pa} . The fishing mortality (F) has been below F_{pa} since 2013. Recruitment (R) has been close to the long-term geometric mean level in the last decade.

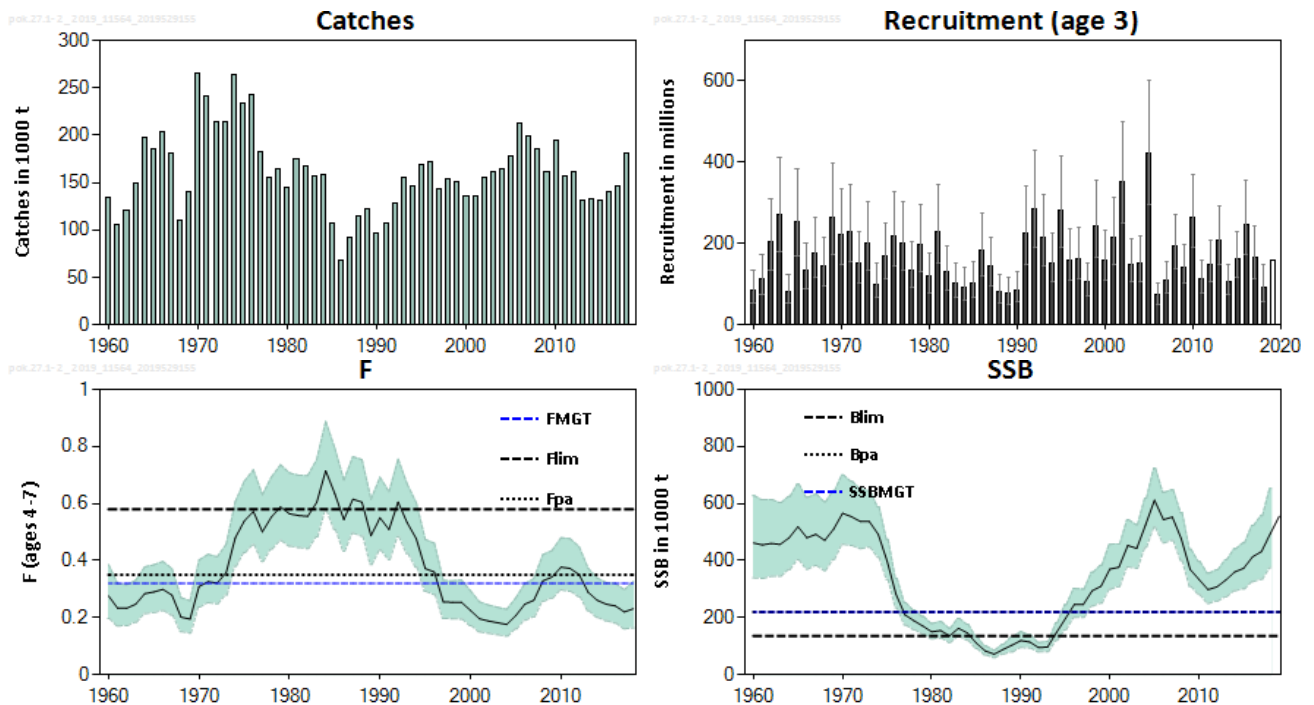


Figure 1 Saithe in subareas 1 and 2. Historical development of the stock from the summary of stock assessment (weights in thousand tonnes). Uncertainty boundaries (95%) for recruitment (R), fishing mortality (F), and spawning-stock biomass (SSB) are shown in the plots. Predicted recruitment values are not shaded.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is below F_{pa} , F_{lim} , and F_{MP} , and that the spawning stock size is above B_{pa} , B_{lim} , and SSB_{MGT} .

Table 1 Saithe 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}	?	?	?	MSY	?	?	?	Undefined
Precautionary approach	F_{pa}, F_{lim}	✓	✓	✓	B_{pa}, B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	✓	✓	✓	SSB_{MGT}	✓	✓	✓	Above

Catch scenarios

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

Variable	Value	Notes
$F_{\text{ages 4-7}}$ (2019)	0.22	F corresponding to TAC constraint
SSB (2020)	537 009	Based on catch constraint
$R_{\text{age 3}}$ (2019 onwards)	159 108	Geometric mean (1960–2018)
Total catch (2019)	149 550	TAC

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

Basis	Total catch (2020)	F_{total} (2020)	SSB (2021)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management plan	171 982	0.26	483 172	-10	15	15
Other scenarios						
$F = 0$	0	0	642 238	20	-100	-100
F_{pa}	223 980	0.35	458 092	-19	50	50
$F = F_{\text{sq}}$	156 484	0.23	497 334	-7	5	5
$F = F_{\text{sq}} \times 0.5$	82 932	0.115	565 038	5	-45	-45
$F = F_{\text{sq}} \times 1.25$	190 101	0.29	466 666	-13	27	27

* SSB 2021 relative to SSB 2020.

** Catch in 2020 relative to TAC in 2019 (149 550 tonnes).

*** Catch in 2020 relative to advice value for 2019 (149 550 tonnes).

The 3-year prediction fishing at F_{MP} gives catches of 207 794, 188 110, and 172 354 tonnes in 2020, 2021, and 2022 respectively. The average of these is 189 419 tonnes, which is more than a 15% increase on the 2019 TAC (149 550 tonnes). Using the 15% constraint as outlined in the HCR gives a catch of 171 982 tonnes.

The advised catch for 2020 is higher than that advised for 2019 because the stock in 2019 is estimated to be larger than in 2018, partly due to higher survey indices in 2018.

Basis of the advice

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

Advice basis	Norwegian management plan
Management plan	<p>The harvest control rule, as revised in 2013 and communicated to ICES by the Norwegian Ministry of Fisheries and Coastal Affairs, contains the following elements:</p> <p>Estimate the average TAC level for the coming 3 years based on $F_{\text{MP}} = 0.32$. TAC for the next year will be set to this level as a starting value for the 3-year period.</p> <p>The year after, the TAC calculation for the next 3 years is repeated based on the updated information about the stock development. However, the TAC should not be changed by more than +/- 15% compared with the previous year's TAC.</p> <p>If the spawning-stock biomass (SSB) in the beginning of the year for which the quota is set (first year of prediction), is below B_{pa}, the procedure for establishing TAC should be based on a fishing mortality that is linearly reduced from F_{MP} at $\text{SSB} = B_{\text{pa}}$ to 0 at SSB equal to zero. At SSB levels below B_{pa} in any of the operational years (current year and 3 years of prediction) there should be no limitations on the year-to-year variations in TAC.</p> <p>The harvest control rule (HCR) was last evaluated by ICES in 2011 (ICES, 2011), with $F_{\text{MP}} = 0.35$. The evaluation concluded that the HCR is precautionary. The F_{MP} was lowered to the current value of 0.32 by Norwegian authorities in 2013. The inter-benchmark for this stock in 2014 (ICES, 2014) did not result in significantly different estimates of stock dynamics and the former HCR evaluation is still considered valid.</p>

Quality of the assessment

The assessment is fairly consistent over recent years. The variability in the assessment is taken into account by the harvest control rule in the management plan. Predicted catches are dependent upon assumptions of average recruitment as reliable recruitment estimates are lacking.

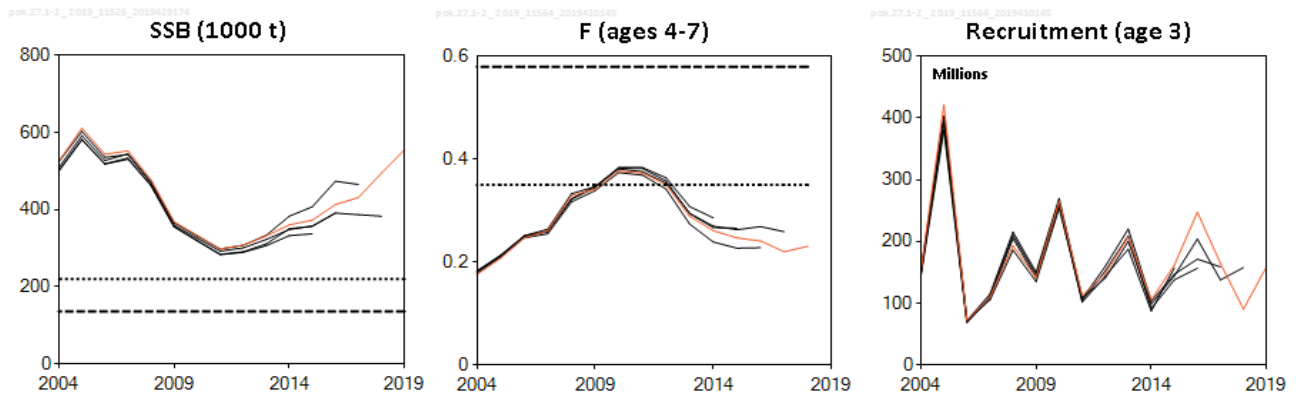


Figure 2 Saithe in Subareas 1 and 2. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

The current catch of *Sebastes norvegicus*, taken as bycatch in fisheries targeting Northeast Arctic (NEA) saithe, constitutes a considerable part of the total *Sebastes norvegicus* catch. Bycatch of *Sebastes norvegicus* should be kept as low as possible because of the poor status of this stock.

Bycatch of coastal cod should be kept as low as possible in order to obtain the reductions in fishing mortality implied by the coastal cod rebuilding plan.

Reference points

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

Framework	Reference point	Value	Technical basis	Reference
MSY approach	MSY $B_{trigger}$	Not defined		
	F_{MSY}	Not defined		
Precautionary approach	B_{lim}	136 000 t	Change point regression.	ICES (2005)
	B_{pa}	220 000 t	$B_{lim} \times \exp(1.645 \times \sigma)$, where $\sigma = 0.3$.	ICES (2005)
	F_{lim}	0.58	F corresponding to an equilibrium stock = B_{lim} .	ICES (2005)
	F_{pa}	0.35	$F_{lim} \times \exp(-1.645 \times \sigma)$, where $\sigma = 0.3$. This value is considered to have a 95% probability of avoiding the F_{lim} .	ICES (2005)
Management plan	SSB_{MGT}	220 000 t	B_{pa} .	ICES (2011)
	F_{MP}	0.32	Set by Norwegian authorities, modifying the value evaluated in MSE (0.35).	ICES (2011, 2014)

Basis of the assessment

Table 6 Saithe 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 catches (international landings, ages and length frequencies from Norwegian, German, and Russian catch sampling); one survey index (NOcoast-Aco-4Q, split in 2002) recalculated for the period 2004–2018 (using StoX); three-year running average maturity based on spawning zones from otoliths from commercial catches and surveys for 1985–2006, constant (2005–2007 average) for later years.
Discards and bycatch	Discarding is considered negligible. Bycatch is included.
Indicators	None.
Other information	An inter-benchmark was undertaken in 2014 (ICES IBP NEA SAITHE; ICES, 2014).
Working group	Arctic Fisheries Working Group (AFWG).

Information from stakeholders

No additional information was provided.

History of the advice, catch, and management

Table 7 Saithe in subareas 1 and 2. ICES advice, TAC and catches. All weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Agreed TAC [§]	ICES catches
1994	No increase in F	158000 [#]	145000	146950
1995	No increase in F	221000 [#]	165000	168378
1996	No increase in F	158000 [#]	163000	171348
1997	Reduction of F to F_{med} or below	107000	125000	143629
1998	Reduction of F to F_{med} or below	117000	145000 ^{##}	153327
1999	Reduce F below F_{pa}	87000	144000 ^{###}	150375
2000	Reduce F below F_{pa}	89000	125000 [^]	135928
2001	Reduce F below F_{pa}	< 115000	135000	135853
2002	Maintain F below F_{pa}	< 152000	162000 ^{^^}	154870
2003	Maintain F below F_{pa}	< 168000	164000	161592
2004	Maintain F below F_{pa}	< 186000	169000	164636
2005	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F_{pa}	< 215000	215000	178568
2006	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F_{pa}	< 202000	193500	212557
2007	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F_{pa}	< 247000	222525	198967
2008	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F_{HCR}	< 247000	< 247000	184840
2009	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 225000	225000	161865
2010	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 204000	204000	195554
2011	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 173000	173000	157048
2012	Take account of coastal cod and <i>Sebastes marinus</i> * bycatch. Apply management plan.	< 164000	164000	160960
2013	Take account of coastal cod and <i>Sebastes marinus</i> * bycatch. Apply management plan.	< 164000	140000 ^{^^^}	131629
2014	Take account of coastal cod and <i>Sebastes marinus</i> * bycatch. Stabilize SSB.	< 140000	119000 ^{^^^}	132070
2015	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	< 122000	122000	132275
2016	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	< 140000	140000	141768
2017	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 150000	150000	145819

Year	ICES advice	Catch corresponding to advice	Agreed TAC [§]	ICES catches
2018	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 172500	172500	181280
2019	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 149550	149550	
2020	Apply management plan.	≤ 171982		

Predicted catch at *status quo* F.

TAC first set at 125 000 tonnes, then increased in May 1998 after an intersessional assessment.

TAC set after an intersessional assessment in December 1998.

^ TAC set after an intersessional assessment in December 1999.

^^ TAC first set at 152 000 tonnes, then increased in June 2003 after the spring 2002 assessment.

^^^ Set by Norwegian authorities based on national advice where CPUE was excluded from the assessment.

§ TAC set by Norwegian authorities.

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

History of the catch and landings

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

Catch (2018)	Landings				Discards	Recreational catch
181 283 tonnes	Trawl 46%	Purse seine 20%	Gillnet 16%	Other 18%	Discarding is considered to be negligible	Imprecisely known, but negligible (< 1% of total catch)
	181 280 tonnes					

Table 9 Saithe in subareas 1 and 2. History of commercial landings. ICES estimated values are presented for each country participating in the fishery. Weights are in tonnes.

Year	Faroes	France	Greenland	Germany, Dem. Rep.	Fed. Rep. Germany	Iceland	Norway	Poland	Portugal	Russian Federation***	Spain	UK	Others^^	Total
1960	23	1700			25948		96050					9780	14	133515
1961	61	3625			19757		77875					4615	18	105951
1962	2	544			12651		101895			912		4699	4	120707
1963		1110			8108		135297					4112		148627
1964		1525			4420		184700			84		6511	186	197426
1965		1618			11387		165531			137		6746	181	185600
1966		2987		813	11269		175037			563		13078	41	203788
1967		9472		304	11822		150860			441		8379	48	181326
1968				1248	4753		96641					8782		111424
1969	20	193		6744	4355		115140					13585	23	140060
1970	1097			29200	23466		151759			43550		15690		264762
1971	215	14536		16840	12204		128499	6017		39397	13097	10467		241272
1972	109	14519		7474	24595		143775	1111		1278	9247	8348		210456
1973	7	11320		12015	30338		148789	23		2411	2115	6841		213859
1974	46	7119		29466	33155		152699	2521		28931	7075	3104	5	264121
1975	28	3156		28517	41260		122598	3860	6430	13389	11397	2763	55	233453
1976	20	5609		10266	49056		131675	3164	7233	9013	21661	4724	65	242486
1977	270	5658		7164	19985		139705	1	783	989	1327	6935		182817
1978	809	4345		6484	19190		121069	35	203	381	121	2827		155464
1979	1117	2601		2435	15323		141346			3	685	1170		164680
1980	532	1016			12511		128878			43	780	794		144554
1981	236	218			8431		166139			121		395		175540
1982	339	82			7224		159643			14		732		168034
1983	539	418			4933		149556			206	33	1251		156936
1984	503	431		6	4532		152818			161		335		158786
1985	490	657		11	1873		103899			51		202		107183
1986	426	308			3470		63090			27		75		67396
1987	712	576			4909		85710			426		57	1	92391
1988	441	411			4574		108244			130		442		114242
1989	388	460**			606		119625			506	506	726		122817
1990	1207	340**			1143		92397			52		709		95848
1991	963	77**			2003		103283			504^		492	5	107327

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Year	Faroes	France	Greenland	Germany, Dem. Rep.	Fed. Rep. Germany	Iceland	Norway	Poland	Portugal	Russian Federation***	Spain	UK	Others^^	Total
1992	165	1980	734		3451		119763			964	6	541		127604
1993	31	566	78		3687	3	140604		1	9509	4**	415	5	154903
1994	67**	557	15		1863	4**	141589		1**	1640**	655**	557	2	146950
1995	172**	358	53		935		165001		5	1148		688	18	168378
1996	248**	346	165		2615		166045		24	1159	6	707	33	171348
1997	193**	560	363**		2915		136927		12	1774	41	799	45	143629
1998	366	932	437**		2936		144103		47	3836	275	355	40	153327
1999	181	638**	655**		2473	146	141941		17	3929	24	339	32	150375
2000	224**	1438	651**		2573	33	125932		46	4452	117	454	8**	135928
2001	537	1279	701**		2690	57	124928		75	4951	119	514	2	135853
2002	788	1048	1393		2642	78	142941		118	5402	37	420	3	154870
2003	2056	1022	929**		2763	80**	150400		147	3894	18	265	18**	161592
2004	3071	255	891**		2161	319	147975		127	9192	87	544	14	164636
2005	3152	447	817**		2048	395	162338		354	8362	25	630		178568
2006	1795	900	779**		2780	255	195462	89	101**	9823	0**	532	42	212557
2007	2048	966	801**		3019	219	178644	99	412	12168	522**	557	12	198967
2008	2405	1009	513**		2264	113	165998	66	348	11577	33**	506	10	184840
2009	1611**	379	697		2021	69	144570	30	184**	11899	2**	379	24**	161865
2010	1632	677	954		1592	124**	175246	279	93	14664	8	283	3**	195554
2011	306	504	445		1371	66	143314		45	10007	2	972	15**	157048
2012	146	781	658		1371	126	143174		8**	13607	4	1087	0	160960
2013	80	1901	972		1212^^^	245**	111961	2	17	14796	5	415	22	131629
2014	273	1674	407		259	659	115864	1	8	12396	12	518	0	132070
2015	766	515	393		424	248	115157	11543	10	13181	34	403	0	132275
2016	1148	526	613		952	702	121705	5230	52	15203	26	301	10	141768
2017	639	680	407		865	589	126947	504	86	14551	88	439	23	145819
2018*	626	937	448		1642		162460	404	51	14171	60	464	17	181280

* Provisional figures.

** As reported to Norwegian authorities.

*** USSR prior to 1991.

^ Includes Estonia.

^^ Includes Denmark, Netherlands, Ireland, and Sweden.

^^^ As reported by working group members.

Summary of the assessment

Table 10 Saithe in subareas 1 and 2. Assessment summary. High and low refer to 95% confidence bounds.

Year	Recruitment (age 3)	Recruitment High	Recruitment Low	SSB	SSB High	SSB Low	Total catch	F (ages 4–7)	F High	F Low
	thousands			tonnes			tonnes			
1960	84953	135625	53213	461689	627718	339573	133515	0.28	0.39	0.197
1961	113991	173281	74988	455025	613137	337687	105951	0.23	0.32	0.171
1962	204021	308555	134901	459946	613958	344568	120707	0.23	0.32	0.172
1963	272404	411390	180374	456518	603096	345564	148627	0.25	0.33	0.184
1964	81247	123774	53331	479946	624751	368704	197426	0.28	0.38	0.21
1965	254964	384722	168970	518913	668257	402944	185600	0.29	0.39	0.22
1966	133647	201136	88803	479829	621914	370205	203788	0.30	0.40	0.23
1967	175109	264169	116074	492147	632661	382841	181326	0.28	0.37	0.21
1968	143445	216059	95235	470746	606608	365312	111424	0.20	0.27	0.151
1969	263307	398218	174102	510616	644568	404502	140060	0.195	0.26	0.146
1970	222544	334922	147873	565689	700004	457145	264762	0.31	0.40	0.24
1971	230101	344569	153659	554013	678081	452646	241272	0.33	0.42	0.25
1972	152826	228594	102171	537029	652133	442242	210456	0.32	0.41	0.25
1973	201514	301495	134688	536980	644777	447205	213859	0.36	0.46	0.28
1974	99937	150114	66532	491972	588002	411626	264121	0.48	0.61	0.38
1975	167491	250838	111838	398071	474256	334125	233453	0.54	0.68	0.43
1976	218085	327547	145204	281688	337787	234905	242486	0.57	0.72	0.46
1977	201382	301557	134484	209744	252408	174292	182817	0.50	0.63	0.40
1978	135201	202694	90182	189232	226188	158315	155464	0.55	0.69	0.44
1979	196410	294009	131211	170643	204056	142701	164680	0.59	0.74	0.47
1980	118184	176858	78976	150451	180039	125725	144554	0.56	0.71	0.45
1981	228873	344868	151892	154708	186140	128584	175540	0.56	0.70	0.45
1982	128955	193635	85880	135940	163486	113036	168034	0.56	0.70	0.44
1983	101770	153232	67590	162762	197398	134204	156936	0.60	0.75	0.48
1984	92939	140588	61440	146367	176972	121055	158786	0.72	0.89	0.57
1985	102179	154512	67571	110846	133576	91985	107183	0.64	0.79	0.51
1986	181485	274676	119911	83484	100721	69196	67396	0.54	0.68	0.43
1987	144147	216195	96109	72113	86835	59887	92391	0.62	0.76	0.50
1988	81210	123108	53571	88171	106928	72705	114242	0.61	0.75	0.49
1989	77229	117336	50831	103206	133312	79899	122817	0.49	0.62	0.39
1990	85530	131015	55836	119544	149954	95302	95848	0.55	0.69	0.44
1991	224375	340259	147958	114596	139936	93844	107327	0.51	0.64	0.40
1992	284775	430334	188451	94977	113113	79749	127604	0.61	0.76	0.48
1993	214176	320446	143148	97175	116824	80832	154903	0.53	0.67	0.43
1994	152907	224499	104146	147869	182186	120016	146950	0.48	0.60	0.38
1995	279958	414389	189137	196889	245281	158045	168378	0.37	0.47	0.29
1996	159923	235220	108730	246126	301873	200675	171348	0.36	0.46	0.28
1997	163808	240444	111598	245371	299969	200710	143629	0.26	0.33	0.197
1998	104103	152225	71194	294112	359259	240778	153327	0.25	0.33	0.196
1999	241993	354045	165404	310104	383467	250776	150375	0.25	0.33	0.195
2000	158151	231316	108128	370374	457391	299911	135928	0.23	0.29	0.172
2001	215548	312527	148663	376555	458667	309143	135853	0.196	0.26	0.150
2002	352556	500016	248584	452970	543079	377812	154870	0.188	0.24	0.145
2003	148627	211364	104512	442949	526343	372768	161592	0.182	0.24	0.140
2004	152693	219522	106208	525691	619219	446290	164636	0.176	0.23	0.135
2005	421639	599610	296491	611511	723537	516830	178568	0.21	0.27	0.160
2006	72565	102647	51298	543695	639526	462224	212557	0.25	0.32	0.191
2007	109959	154973	78021	552527	647870	471214	198967	0.26	0.34	0.20
2008	193144	271643	137329	477066	567796	400833	184840	0.33	0.42	0.26
2009	141340	198250	100766	368792	439514	309450	161865	0.34	0.44	0.27
2010	264731	370278	189270	333601	396658	280568	195554	0.38	0.48	0.30
2011	112113	158706	79199	298212	355777	249961	157048	0.37	0.48	0.29

Year	Recruitment (age 3)	Recruitment High	Recruitment Low	SSB	SSB High	SSB Low	Total catch	F (ages 4–7)	F High	F Low
	thousands			tonnes			tonnes			
2012	148149	208500	105266	307997	367614	258049	160960	0.35	0.45	0.27
2013	206890	290853	147166	331872	402762	273460	131629	0.29	0.37	0.22
2014	105605	148817	74941	360463	441199	294502	132070	0.26	0.34	0.20
2015	161651	227750	114736	372942	462203	300919	132275	0.25	0.32	0.189
2016	247419	353756	173046	413202	522936	326495	141768	0.24	0.32	0.181
2017	164535	241200	112238	431671	556957	334567	145819	0.22	0.30	0.161
2018	90346	146710	55636	494841	652524	375262	181280	0.23	0.33	0.164
2019	159108*			555377				0.22		

* Geometric mean 1960–2018.

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