

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 2019 should be no more than 149 550 tonnes. Bycatches of coastal cod (*Gadus morhua*) and golden redfish (*Sebastes norvegicus*) in fisheries targeting saithe in subareas 1 and 2 should be kept as low as possible.

Stock development over time

The spawning-stock biomass (SSB) has been above B_{pa} since 1996, but declined considerably from 2007 to 2011, then increased again and is presently (2018) estimated to be well above B_{pa} . The fishing pressure (F) has been below F_{pa} since 1997, with the exception of 2010 and 2011. Recruitment (R) has been close to the long-term geometric mean level after 2005.

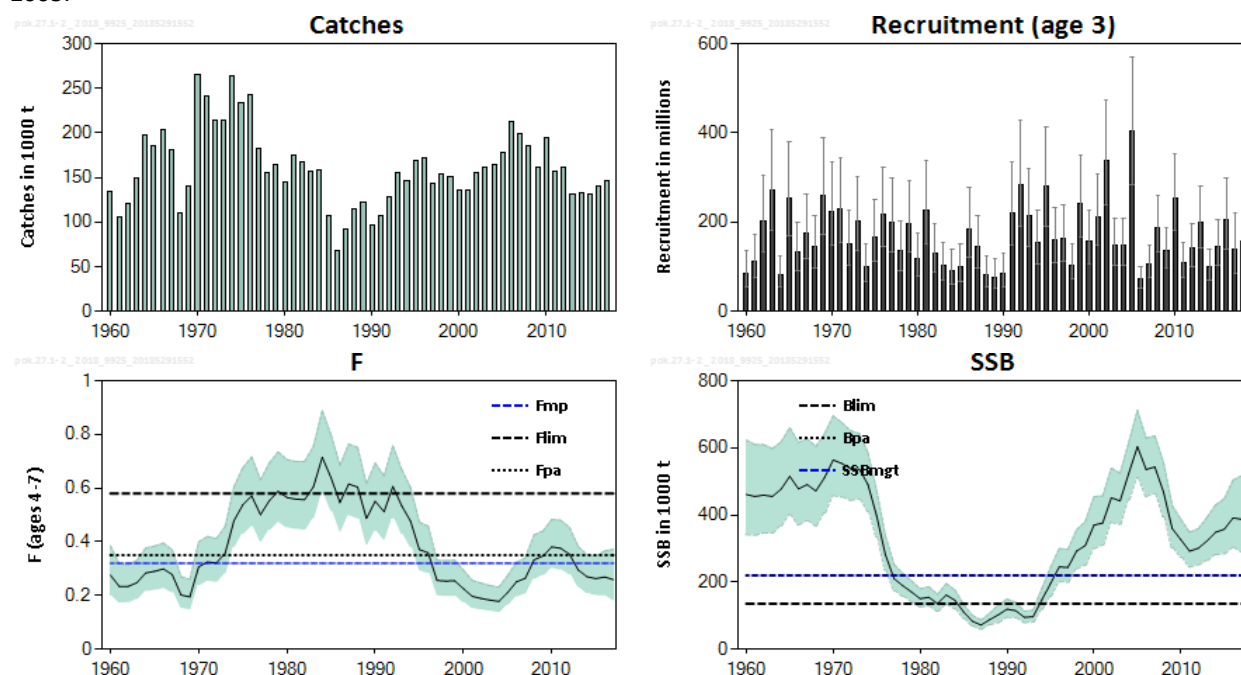


Figure 1 Saithe in subareas 1 and 2. Historical development of the stock from the summary of stock assessment (weights in thousand tonnes). Recruitment (R), fishing mortality (F), and spawning-stock biomass (SSB) have uncertainty boundaries (95%) in the plots. Predicted recruitment values are not shaded.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is below F_{pa} , F_{lim} , and F_{MP} , and 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				
		2015	2016	2017	2016	2017	2018		
Maximum Sustainable Yield	F_{MSY}	?	?	?	MSY	?	?	?	Undefined
Precautionary Approach	F_{pa} , F_{lim}	✓	✓	✓	B_{pa} , B_{lim}	✓	✓	✓	Full reproductive capacity
Management plan	F_{MP}	✓	✓	✓	SSB_{MGT}	✓	✓	✓	Above

Catch scenarios

Table 2 Saithe in subareas 1 and 2. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{\text{ages 4-7}}$ (2018)	0.34	F corresponding to TAC constraint
SSB (2019)	368 000	
$R_{\text{age 3}}$ (2017 onwards)	157 722	Geometric mean (1960–2016), in thousands
Total catch (2018)	172 500	TAC

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

Basis	Total catch (2019)	F_{total} (2019)	SSB (2020)	% SSB change *	% TAC change **	% Advice change ***
ICES advice basis						
Management Plan	149550	0.309	350305	-4.8	-13.3	-13.3
Other scenarios						
$F = 0$	0	0	485926	32	-100	-100
F_{pa}	166276	0.35	335414	-8.9	-3.6	-3.6
$F = F_{\text{sq}}$	130298	0.26	367525	-0.1	-24	-24
$F = F_{\text{sq}} \times 0.5$	69375	0.13	422512	15	-60	-60
$F = F_{\text{sq}} \times 1.25$	157937	0.33	342830	-7	-8	-8

* SSB 2020 relative to SSB 2019.

** Catch in 2019 relative to TAC in 2018 (172 500 t).

*** Advice value for 2019 relative to advice value for 2018.

The 3-year prediction, gives catches of 154150, 148760, and 145740 t in 2019, 2020, and 2021, respectively. The average of this is 149550 t.

The advised catch for 2019 is lower than that advised for 2018 because the stock is estimated to be lower than last year, partly due to a change in the methodology used for calculating survey indices. Due to the management plan, the downward trend in predicted catch causes the advised TAC to be lower than if based solely on the 2019 forecast.

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> <ul style="list-style-type: none"> 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. 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. 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>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 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 low level of biological sampling, which was an issue following the termination of the original Norwegian port-sampling programme in 2009, improved in 2016. Issues still remain particularly for the purse seine in some areas and quarters.

The consistent retrospective pattern of underestimating SSB and overestimating F seen in the previous three assessments appears to have been reconciled with the current assessment which uses the revised survey indices (StoX processing).

Predicted catches are dependent upon assumptions of average recruitment as reliable recruitment estimates are lacking.

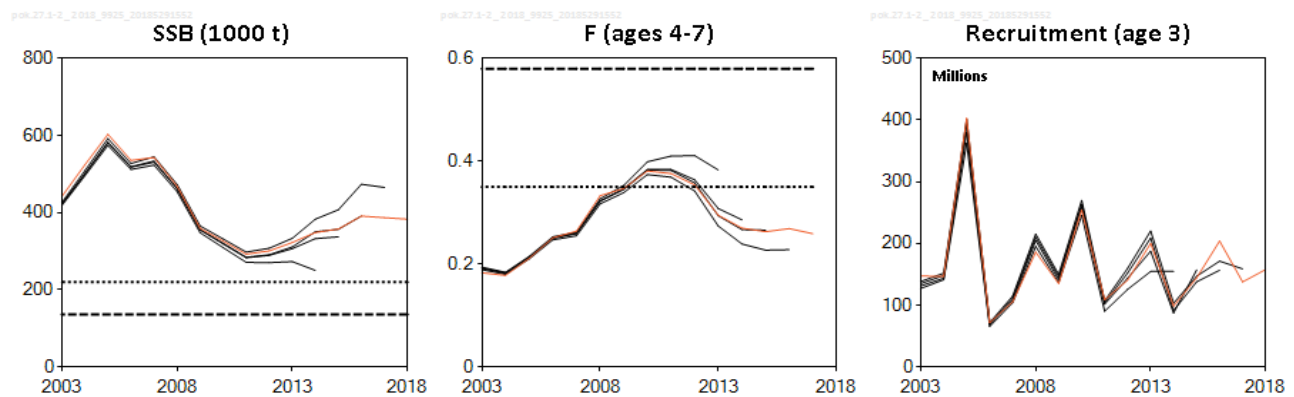


Figure 2 Saithe in Subareas 1 and 2. Historical assessment results (final-year recruitment estimates included). 2013 omitted because no assessment was accepted.

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} ; F is linearly reduced from F_{pa} at $SSB = B_{pa}$ to zero at $SSB = 0$.	ICES (2011)
	F_{MP}	0.32	Average TAC for the coming three years based on F_{MP}	ICES (2011)

Basis of the assessment

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

ICES stock data category	1 (ICES, 2016)
Assessment type	Age-based analytical assessment (SAM; ICES, 2018) that uses landings 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 using StoX for the period 2004–2017; 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	Predicted catch corresponding to advice	Agreed TAC [§]	ICES catches
1994	No increase in F	158000 [#]	145000	145860
1995	No increase in F	221000 [#]	165000	168248
1996	No increase in F	158000 [#]	163000	171121
1997	Reduction of F to F _{med} or below	107000	125000	143073
1998	Reduction of F to F _{med} or below	117000	145000 ^{##}	152890
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	212822
2007	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F _{pa}	< 247000	222525	199008
2008	Take account of <i>Sebastes marinus</i> bycatch. Maintain F below F _{HCR}	< 247000	< 247000	184740
2009	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 225000	225000	161853
2010	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 204000	204000	194837
2011	Take account of <i>Sebastes marinus</i> bycatch. Apply management plan	< 173000	173000	156716
2012	Take account of coastal cod and <i>Sebastes marinus</i> ^{**} bycatch. Apply management plan.	< 164000	164000	160865
2013	Take account of coastal cod and <i>Sebastes marinus</i> ^{**} bycatch. Apply management plan.	< 164000	140000 ^{^^^}	131806
2014	Take account of coastal cod and <i>Sebastes marinus</i> ^{**} bycatch. Stabilize SSB.	< 140000	119000 ^{^^^}	132005
2015	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	< 122000	122000	131765

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC [§]	ICES catches
2016	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	< 140000	140000	140392
2017	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 150000	150000	146220
2018	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 172500	172500	
2019	Take account of coastal cod and <i>Sebastes norvegicus</i> bycatch. Apply management plan.	≤ 149550		

Predicted catch at *status quo* F.

TAC first set at 125 000 t, 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 t, 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*. From 2015 it was decided to adopt the species list by WoRMS (<http://www.marinespecies.org/>). The name used for this species will hence hereafter be *Sebastes norvegicus*.

History of the catch and landings

Table 8 Saithe in subareas 1 and 2. Catch distribution by fleet in 2017 as estimated by ICES.

Catch (2017)	Landings				Discards	Recreational catch
	Trawl:	Purse seine:	Gillnet:	Other:		
146220 t	44%	22%	15%	19%	Discarding is considered to be negligible	Imprecisely known, but negligible (< 1% of total catch)
	146220 t					

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	Faroese	France	Greenland	Germany, Dem. Rep.	Fed. Rep. Germany	Iceland	Norway	Poland	Portugal	Russian Federation***	Spain	UK	Others^^	Total all countries
1960	23	1700			25948		96050					9780	14	133515
1961	61	3625			19757		77875					4595	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		6741	181	185600
1966		2987		813	11269		175037			563		13078	41	203788
1967		9472		304	11822		150860			441		8379	48	181326
1968				70	4753		96641					8781		110247
1969	20	193		6744	4355		115140					13585	23	140060
1970	1097			29362	23466		151759			43550		15469		264924
1971	215	14536		16840	12204		128499	6017		39397	13097	10361		241272
1972	109	14519		7474	24595		143775	1111		1278	13125	8223		214334
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

Year	Faroes	France	Greenland	Germany, Dem. Rep.	Fed. Rep. Germany	Iceland	Norway	Poland	Portugal	Russian Federation***	Spain	UK	Others^^	Total all countries
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	899	786**		2779	255	195462	89	339**	9823	21**	532	42	212822
2007	2048	966	810**		3019	219	178644	99	412	12168	53**	558	12	199008
2008	2314	1009	503**		2263	113	165998	66	348	11577	33**	506	10	184740
2009	1611**	326	697		2021	69	144570	30	204**	11899	2**	379	45**	161853
2010	1632	677	954		1592	109**	174544	279	93	14664	8	283	2**	194837
2011	112	367	445		1371	65	143314		46	10007	2	972	15	156716
2012	146	781	658		1371	126	143145		23**	13607	4	1000	4**	160865
2013	80	1901	972		1326^^^	290**	111962	2	17	14796	5	433	22	131806
2014	273	1674	407		259	659	115798	1	8	12396	12	518		132005
2015	576	514	393		424	249	114830	1154	10	13181	34	400		131765
2016	1139	526	613		952	301	120740	528	53	15203	26	301	10	140392
2017*	638	838	407		1142	560	126946	504	86	14551	88	439	23	146220

* 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.

Year	Recruitment			SSB			Catch tonnes	F		
	Age 3	97.5 percentile	2.5 percentile	SSB	97.5 percentile	2.5 percentile		Mean F ages 4-7	97.5 percentile	2.5 percentile
	thousands			tonnes						
1960	85698	136061	53976	461034	623109	341116	133515	0.28	0.39	0.198
1961	113076	170954	74793	455183	609470	339954	105951	0.23	0.32	0.172
1962	201627	303289	134042	459180	609233	346084	120707	0.23	0.32	0.173
1963	270041	405725	179734	455083	597826	346423	148627	0.25	0.33	0.185
1964	82519	125104	54429	476993	617696	368341	197426	0.28	0.38	0.21
1965	253911	381196	169127	515080	660045	401953	185600	0.29	0.38	0.22
1966	133781	200292	89356	477779	616024	370558	203788	0.30	0.40	0.23
1967	175857	263885	117194	490630	627475	383630	181326	0.28	0.37	0.21
1968	143659	215236	95885	471425	604114	367881	110247	0.20	0.27	0.151
1969	258934	389690	172052	511093	642083	406826	140060	0.195	0.26	0.147
1970	223572	335056	149182	563897	695088	457468	264924	0.31	0.40	0.24
1971	229531	342298	153914	553344	674826	453731	241272	0.33	0.42	0.25
1972	152147	226648	102135	537655	650776	444198	214334	0.32	0.41	0.25
1973	201465	300395	135116	536480	642571	447905	213859	0.36	0.46	0.28
1974	100037	149832	66791	490485	585144	411138	264121	0.48	0.61	0.38
1975	167059	249493	111861	397311	472575	334033	233453	0.54	0.68	0.43
1976	215953	323463	144177	281954	337520	235536	242486	0.57	0.72	0.46
1977	200284	299057	134134	210379	252711	175137	182817	0.50	0.63	0.40
1978	134556	201171	89999	189312	225965	158604	155464	0.55	0.69	0.44
1979	196477	293286	131623	170721	203884	142952	164680	0.59	0.74	0.47
1980	118209	176331	79245	150628	179969	126070	144554	0.56	0.71	0.45
1981	225130	338647	149665	154839	185999	128899	175540	0.56	0.70	0.45
1982	130153	194966	86885	136079	163428	113307	168034	0.56	0.70	0.44
1983	102947	154514	68590	161606	195751	133417	156936	0.61	0.76	0.49
1984	92099	138951	61045	145847	176205	120719	158786	0.72	0.89	0.58
1985	101179	152334	67202	110963	133699	92093	107183	0.64	0.80	0.51
1986	183509	276777	121671	83531	100765	69244	67396	0.55	0.68	0.44
1987	144244	215330	96625	72188	86922	59952	92391	0.62	0.76	0.50
1988	82391	124354	54589	88213	106900	72793	114242	0.60	0.75	0.49
1989	77101	116657	50958	102840	132574	79776	122817	0.49	0.62	0.39
1990	84618	129070	55476	119244	149376	95190	95848	0.55	0.69	0.44
1991	220936	333203	146495	114724	139945	94048	107327	0.51	0.65	0.41
1992	284270	427487	189034	94913	113003	79718	127604	0.61	0.76	0.49
1993	215134	320221	144534	97008	116468	80800	154903	0.53	0.67	0.43
1994	154347	225436	105675	147107	180947	119596	146950	0.48	0.60	0.38
1995	281138	414229	190809	195938	243464	157690	168378	0.37	0.47	0.29
1996	159831	233706	109308	245151	299869	200418	171348	0.36	0.46	0.28
1997	162640	237232	111501	243935	297155	200247	143629	0.26	0.33	0.198
1998	103916	151017	71505	292424	355981	240214	153327	0.25	0.33	0.196
1999	240133	349157	165152	308820	380520	250630	150375	0.26	0.33	0.196
2000	155717	226116	107236	369761	454917	300545	135928	0.23	0.29	0.173
2001	212680	306324	147663	376061	456549	309762	135853	0.197	0.26	0.151
2002	336689	474438	238935	451408	539778	377505	154870	0.189	0.25	0.146
2003	147218	208159	104117	441867	523885	372690	161592	0.183	0.24	0.141
2004	146785	209205	102989	524070	616179	445730	164636	0.178	0.23	0.136
2005	402895	569800	284880	603218	711811	511193	178568	0.21	0.27	0.163
2006	71788	101079	50985	535534	628862	456056	212822	0.25	0.32	0.194
2007	105499	147746	75333	542961	635603	463821	199008	0.26	0.34	0.21
2008	186012	260441	132853	468568	556441	394572	184740	0.33	0.43	0.26
2009	135048	188511	96748	359510	427431	302383	161853	0.35	0.44	0.27
2010	254192	354092	182476	326226	387139	274898	194837	0.38	0.48	0.30

Year	Recruitment			SSB			Catch	F		
	Age 3	97.5 percentile	2.5 percentile	SSB	97.5 percentile	2.5 percentile		Mean F ages 4-7	97.5 percentile	2.5 percentile
	thousands			tonnes						
2011	108793	153675	77018	292297	348349	245263	156716	0.38	0.48	0.29
2012	140590	196946	100361	300713	359182	251761	160865	0.35	0.45	0.28
2013	200217	280769	142775	322562	392976	264765	131806	0.30	0.38	0.23
2014	98665	138660	70206	348389	429903	282330	132005	0.27	0.35	0.21
2015	144280	204071	102008	357411	448829	284613	131845	0.26	0.35	0.199
2016	203897	297678	139660	391081	503838	303559	140392	0.27	0.37	0.198
2017	137704	220745	85901	387061	516802	289892	146221	0.26	0.37	0.180
2018	157722*			383022						

* Geometric Mean 1960–2017

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