Sole (*Solea solea*) in divisions 7.f and 7.g (Bristol Channel, Celtic Sea)

ICES advice on fishing opportunities

ICES advises that when the EU multiannual plan (MAP) for Western Waters and adjacent waters is applied, catches in 2021 that correspond to the F ranges in the plan are between 811 tonnes and 2364 tonnes. According to the MAP, catches higher than those corresponding to F_{MSY} (1413 tonnes) can only be taken under conditions specified in the MAP, whilst the entire range is considered precautionary when applying the ICES advice rule.

Stock development over time

Spawning-stock biomass (SSB) has been above MSY $B_{trigger}$ since 2009; it shows an increasing trend over the last few years and is now close to the highest estimated SSB in the time-series. Fishing mortality (F) has decreased in recent years and has been below F_{MSY} since 2017. Recruitment (R) has been variable; the 2017 and 2019 estimates are among the highest in the time-series.

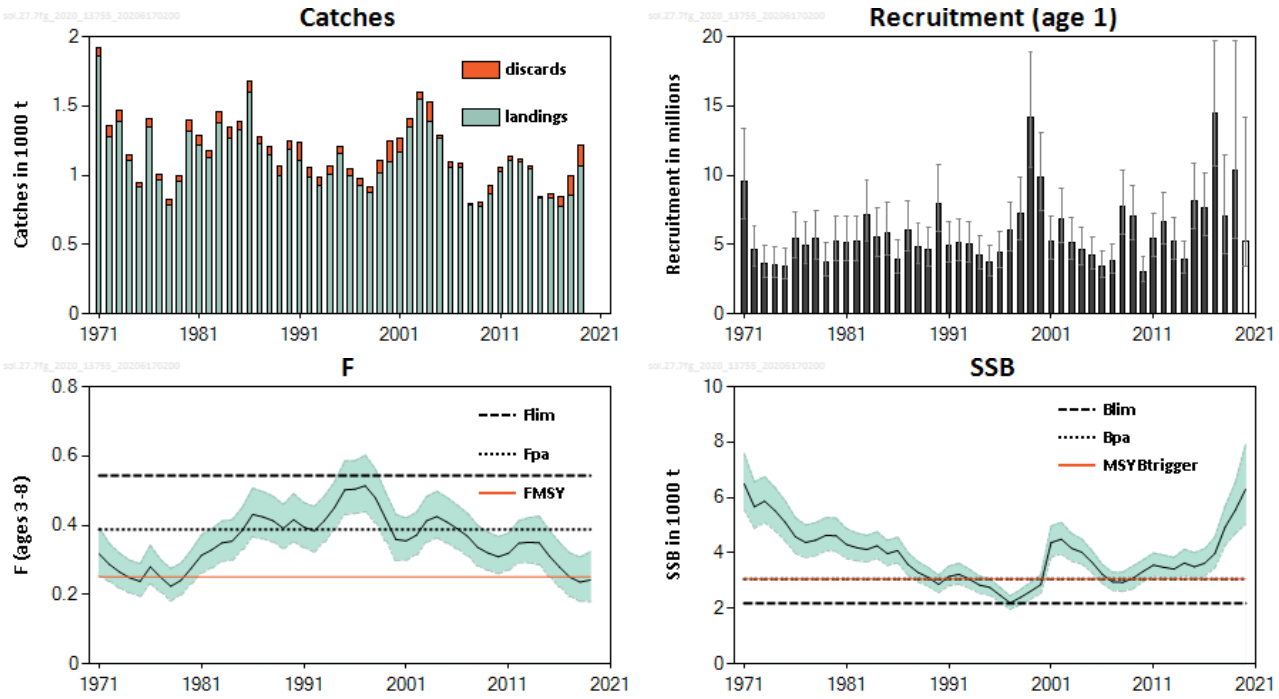

Figure 1 Sole in divisions 7.f and 7.g. Summary of the stock assessment. The assumed recruitment for 2020 is unshaded. Observed discards have only been available since 2004. Discards prior to 2004 are calculated using a discard rate-at-age based on 2004–2018 discard data. The shaded areas on the F and SSB plots, and the error bars on the recruitment plot represent 95% confidence intervals.

Stock and exploitation status

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

Table 1 Sole in divisions 7.f and 7.g. 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}	✓	✓	✓	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}	✓	✓	✓	Within the range	B_{MGT}	✓	✓	✓ Above trigger

Catch scenarios

Table 2 Sole in divisions 7.f and 7.g. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{ages\ 3–8}$ (2020)	0.296	Catch constraint (TAC 2020).
SSB_{2021}	6197	Fishing at F = 0.296; in tonnes.
$R_{age\ 1}$ (2020–2021)	5187	Median resampled recruitment (1971–2017) as estimated by a stochastic projection; in thousands.
Total catch (2020)	1652	TAC 2020; in tonnes.
Projected landings (2020)	1529	Assuming average discard pattern (2017–2019); in tonnes.
Projected discards (2020)	123	Assuming average discard pattern (2017–2019); in tonnes.

Table 3 Sole in divisions 7.f and 7.g. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2021)	Projected landings * (2021)	Projected discards * (2021)	F_{total} (2021)	$F_{projected\ landings}$ (2021)	$F_{projected\ discards}$ (2021)	SSB (2022)	% SSB change **	% TAC change ***	% advice change ^
ICES advice basis										
EU MAP ^^: F_{MSY}	1413	1308	105	0.251	0.239	0.012	6009	−3.0	−14.5	−16.2
EU MAP $F_{MSY\ lower}$	811	752	59	0.136	0.129	0.007	6623	6.9	−51	−18.3 ^^^
EU MAP $F_{MSY\ upper}$	2364	2186	178	0.462	0.439	0.023	5030	−18.8	43	−9 ^^^
Other scenarios										
F = 0	0	0	0	0	0	0	7462	20	−100	−100
F_{pa}	2055	1900	155	0.388	0.368	0.02	5344	−13.8	24	22
F_{lim}	2678	2476	202	0.543	0.515	0.028	4710	−24	62	59
$SSB_{2022} = B_{lim}$	5044	4620	424	1.574	1.494	0.08	2184	−65	205	199
$SSB_{2022} = B_{pa} = MSY\ B_{trigger}$	4169	3834	335	1.081	1.026	0.055	3057	−49	152	147
$F = F_{2020}$	1636	1515	121	0.296	0.281	0.015	5772	−6.9	−0.97	−3.0

* Assuming average discard pattern (2017–2019).
** SSB 2022 relative to SSB 2021.
*** Total catch in 2021 relative to the TAC in 2020 (1652 tonnes).
^ Advice value for 2021 relative to the advice value for 2020 (1686 tonnes).
^^ EU multiannual plan (MAP) for the Western Waters and adjacent waters (EU, 2019).
^^^ Advice value this year relative to the advice value last year for the MAP $F_{MSY\ lower}$ (993 tonnes) and MAP $F_{MSY\ upper}$ (2597 tonnes).

The advice change (−16.2%) is due to a slightly lower predicted biomass in 2021 and the downward revision of the F_{MSY} reference point.

Basis of the advice

Table 4 Sole in divisions 7.f and 7.g. The basis of the advice.

Advice basis	Management plan
Management plan	The EU multiannual plan (MAP) for stocks in Western Waters and adjacent waters applies to this stock. The plan specifies conditions for setting fishing opportunities, depending on stock status and making use of the F_{MSY} range for the stock. In accordance with the MAP, catches higher than those corresponding to F_{MSY} can only be taken providing SSB is greater than MSY $B_{trigger}$, and one of the following conditions is met: a) if it is necessary for the achievement of objectives of mixed fisheries; b) if it is necessary to avoid serious harm to a stock caused by intra- or interspecies stock dynamics; c) in order to limit variations in fishing opportunities between consecutive years to not more than 20%. ICES considers that the F_{MSY} range for this stock used in the MAP is precautionary. Full details of the plan are described in EU (2019).

Quality of the assessment

The benchmark in 2020 (ICES, 2020a) introduced a new assessment model (SAM), using revised abundance and biomass indices. F_{bar} was extended to ages 3–8, compared to the ages 4–8 previously used. Discard data are now included in the input data. The maturity ogive was updated, resulting in higher maturity rate at younger ages, which led to an upward revision of the SSB. This change did not affect the fishable biomass. The changes resulted in a reduced retrospective bias and less variable patterns in fishing mortality.

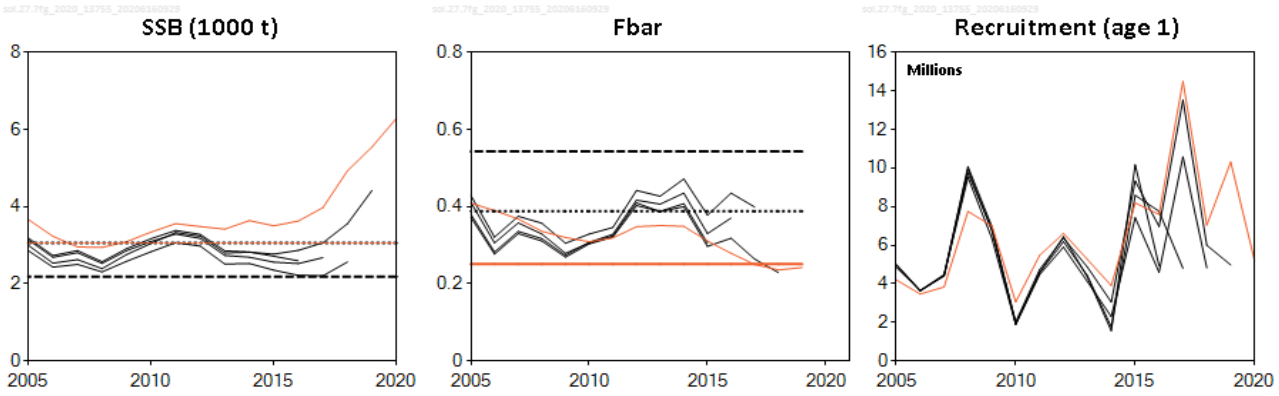

Figure 2 Sole in divisions 7.f and 7.g. Historical assessment results (final-year recruitment assumptions included for each line). This stock was benchmarked in 2020 (ICES, 2020a).

Issues relevant for the advice

The advice for 2021 is lower than the advice for 2020. Because the large 2016 year class has been reduced in abundance through fishing, the biomass is expected to decrease in 2021. This reduction, combined with a revised lower F_{MSY} reference point, results in lower advised catch.

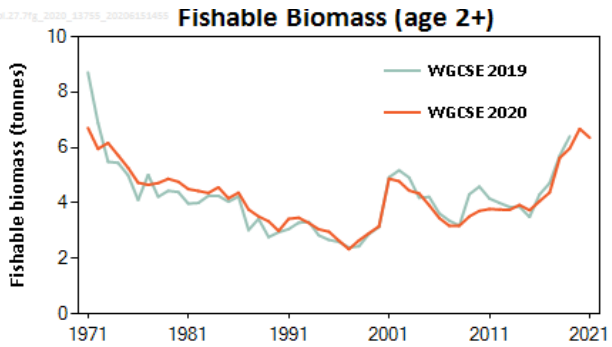

Figure 3 Sole in divisions 7.f and 7.g. Fishable biomass (age 2+ total biomass) from the WGCSE 2019 (ICES, 2019a) and WGCSE 2020 (ICES, 2020b) assessments. The fishable biomass for 2020 and 2021 are derived from the forecast, assuming catch constraint (TAC 2020).

Reference points

Table 5 Sole in divisions 7.f and 7.g. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	3057	B_{pa}; in tonnes.	ICES (2020b)
	F_{MSY}	0.251	EQsim analysis based on the recruitment period 1971–2018	ICES (2020b)
Precautionary approach	B_{lim}	2184	B_{loss} estimated in 2020, corresponding to SSB in 1997; in tonnes.	ICES (2020b)
	B_{pa}	3057	B_{lim} × 1.4; in tonnes.	ICES (2020b)
	F_{lim}	0.543	EQsim analysis, based on the recruitment period 1971–2018.	ICES (2020b)
	F_{pa}	0.388	$F_{lim} \times \exp(-1.645 \times 0.2) \approx F_{lim} / 1.4$	ICES (2020b)
	$F_{p.05}$	0.402	The F that provides 5% probability of SSB < B_{lim} when ICES advice rule is applied.	ICES (2020b)
Management plan	MAP MSY $B_{trigger}$	3057	MSY $B_{trigger}$; in tonnes.	EU (2019), ICES (2020b)
	MAP B_{pa}	3057	B_{pa}; in tonnes.	EU (2019), ICES (2020b)
	MAP B_{lim}	2184	B_{lim}; in tonnes.	EU (2019), ICES (2020b)
	MAP F_{MSY}	0. 251	F_{MSY}	EU (2019), ICES (2020b)
	MAP range F_{lower}	0.136–0.251	Consistent with ranges provided by ICES (2020b), resulting in no more than 5% reduction in long-term yield compared with MSY.	EU (2019), ICES (2020b)
	MAP range F_{upper}	0.251–0.462	Consistent with ranges provided by ICES (2020b), resulting in no more than 5% reduction in long-term yield compared with MSY.	EU (2019), ICES (2020b)

Basis of the assessment

Table 6 Sole in divisions 7.f and 7.g. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2019b)
Assessment type	Age-based analytical assessment (SAM; Nielsen and Berg, 2014; ICES, 2020a) that uses landings and discards in the model and in the forecast.
Input data	Total international landings, ages and length frequencies from catch sampling by métier; one survey index (UK[E&W]-BTS-Q3 1988–2019); five commercial biomass indices (BE-CBT[1971–1983 and 1984–1996], BE-CBT3 [2006–2019], and UK(E&W)-CBT [1984–2005 and 2006–2019]); maturity data (ICES, 2020a); natural mortality is assumed to be constant. Catch numbers for age 1 and 2 prior to 2004 are not used in the assessment model.
Discards and bycatch	Discard numbers available from 2004 onwards. Discards prior to 2004 are calculated using a constant ratio of discards to landings by age based on data from 2004–2018 (ICES, 2020a).
Indicators	None.
Other information	Last benchmark in 2020 (ICES, 2020a).
Working group	Working Group for the Celtic Seas Ecoregion (WGCSE).

Information from stakeholders

No additional information is available.

History of the advice, catch, and management

Table 7 Sole in divisions 7.f and 7.g. History of ICES advice, agreed TAC, official landings, and ICES estimates for landings and discards. All weights are in tonnes.

Year	ICES advice	Catches corresponding to advice	Landings corresponding to advice	Agreed TAC	Official landings	ICES landings	ICES discards
1987	*Status quo* F; TAC		1600	1600	1264	1222	
1988	F = F (pre-86); TAC		900	1100	1204	1146	
1989	F at F (81–85); TAC		1000	1000	992	992	
1990	No increase in F		1200	1200	1239	1189	
1991	No increase in F		1100	1200	1496	1107	
1992	No long-term gains in increasing F		1100	1200	1060	981	
1993	No long-term gains in increasing F		-	1100	1030	928	
1994	No long-term gains in increasing F		-	1100	1018	1009	
1995	No increase in F		1000	1100	1165	1157	
1996	20% reduction in F		800	1000	1081	995	
1997	20% reduction in F		800	900	1038	927	
1998	20% reduction in F		700	850	1013	875	
1999	Reduce F below F_{pa}		810	960	947	1012	
2000	Reduce F below F_{pa}		< 1160	1160	1040	1091	
2001	Reduce F below F_{pa}		< 810	1020	1120	1168	
2002	Reduce F below F_{pa}		< 1000	1070	1118	1345	
2003	Reduce F below F_{pa}		< 1240	1240	1207	1392	
2004	Reduce F below F_{pa}		< 1000	1050	1130	1249	140
2005	Reduce F below F_{pa}		< 840	1000	997	1044	23
2006	Reduce F below F_{pa}		< 880	950	921	946	41
2007	Reduce F below F_{pa}		< 840	893	943	945	36
2008	Keep F below F_{pa}		< 1000	964	780	800	8
2009	No long-term gains in increasing F		< 940	993	807	805	30
2010	No long-term gains in increasing F		< 920	993	871	876	56
2011	See scenarios		-	1241	1013	1029	28
2012	MSY approach		< 1060	1060	1099	1104	32
2013	MSY approach		< 1100	1100	1086	1092	26
2014	MSY approach		< 920	1001	1044	1042	27
2015	MSY approach		< 652	851	827	830	17
2016	MSY approach	≤ 760	≤ 745	779	831	831	31
2017	MSY approach	≤ 806		845	780	776	65
2018	MSY approach	≤ 931		920	849 *	850	141
2019	MSY approach	≤ 864		1009	1068 *	1068	145
2020 **	Management plan	1686 (range 993–2597)		1652			
2021	Management plan	1413 (range 811–2364)					

* Preliminary.
** Catch advice for 2020 updated in October 2019 (ICES, 2019c).

History of the catch and landings

Table 8 Sole in divisions 7.f and 7.g. Catch distribution by fleet in 2019 as estimated by ICES.

Total catch	Landings			Discards	
1213 tonnes	Beam trawlers	Otter trawlers	Other gears	Beam trawlers	Otter trawlers
	84%	13%	3%	90%	10%
	1068 tonnes			145 tonnes	

Table 9 Sole in divisions 7.f and 7.g. History of official and ICES estimated landings. All weights are in tonnes.

Year	Belgium	Denmark	France	Ireland	UK (E. and W., N.I.)	UK (Scotland)	Other	Total official	ICES landings
1986	1039 *	2	146	188	611	-	3	1989	1600
1987	701 *	-	117	9	437	-	-	1264	1222
1988	705 *	-	110	72	317	-	-	1204	1146
1989	684 *	-	87	18	203	-	-	992	992
1990	716 *	-	130	40	353	0	-	1239	1189
1991	982 *	-	80	32	402	0	-	1496	1107
1992	543 *	-	141	45	325	6	-	1060	981
1993	575 *	-	108	51	285	11	-	1030	928
1994	619 *	-	90	37	264	8	-	1018	1009
1995	763 *	-	88	20	294	-	-	1165	1157
1996	695 *	-	102	19	265	0	-	1081	995
1997	660 *	-	99	28	251	0	-	1038	927
1998	675 *	-	98	42	198	-	-	1013	875
1999	604	-	61	51	231	0	-	947	1012
2000	694	-	74	29	243	-	-	1040	1091
2001	720	-	77	35	288	-	-	1120	1168
2002	703	-	65	32	318	-	-	1118	1345
2003	715	-	124	26	342	-	-	1207	1547
2004	735	-	79	33	283	-	-	1130	1398
2005	645	-	101	34	217	-	-	997	1118
2006	576	-	75	38	232	-	-	921	946
2007	582	-	85	32	244	-	-	943	945
2008	466	-	68	28	218	-	-	780	800
2009	513	-	74	26	194	-	-	807	805
2010	620	-	45	27	179	-	-	871	876
2011	766	-	50	30	168	-	-	1013	1029
2012	843	-	48	33	175	-	-	1099	1104
2013	789	-	49	42	206	-	-	1086	1092
2014	705	-	59	28	252	-	-	1044	1042
2015	671	-	24	27	105	-	-	827	830
2016	563	-	72	21	175	-	-	831	831
2017	553	-	49	28	149	-	-	780	776
2018	607	-	44	28	171	-	-	849	850
2019 **	800	-	42	33	193	-	< 1	1068	1068

* Including divisions 7.g–k.
**Preliminary.

Summary of the assessment

Table 10 Sole in divisions 7.f and 7.g. Assessment summary. Weights are in tonnes and recruitment in thousands.

Year	Recruitment age 1			SSB			Landings **	Discards ***	Fishing mortality ages 3–8		
	Value	High	Low	Value	High	Low			Value	High	Low
1971	9588	13386	6868	6492	7577	5562	1861	62	0.32	0.39	0.26
1972	4678	6375	3433	5665	6564	4889	1278	74	0.29	0.35	0.24
1973	3589	4906	2626	5869	6752	5101	1391	81	0.27	0.32	0.22
1974	3529	4814	2587	5532	6363	4809	1105	36	0.25	0.30	0.21
1975	3456	4727	2526	5110	5882	4439	919	26	0.24	0.29	0.196
1976	5452	7383	4026	4585	5273	3986	1350	57	0.28	0.34	0.23
1977	4915	6651	3631	4380	5007	3832	961	41	0.25	0.30	0.21
1978	5424	7404	3973	4463	5097	3907	780	45	0.22	0.28	0.183
1979	3770	5167	2750	4637	5275	4076	954	45	0.24	0.29	0.20
1980	5187	7026	3830	4618	5253	4060	1314	81	0.28	0.33	0.23
1981	5174	7007	3821	4306	4880	3800	1212	70	0.31	0.37	0.26
1982	5226	7085	3855	4189	4716	3722	1128	51	0.33	0.39	0.28
1983	7100	9653	5222	4128	4635	3677	1373	81	0.35	0.41	0.30
1984	5575	7598	4090	4259	4761	3810	1266	77	0.35	0.42	0.30
1985	5862	8061	4263	3976	4453	3549	1328	59	0.39	0.45	0.33
1986	3905	5302	2877	4085	4573	3650	1600	80	0.43	0.51	0.37
1987	6085	8181	4526	3587	4017	3203	1222	56	0.42	0.50	0.36
1988	4846	6498	3615	3297	3684	2951	1146	61	0.41	0.48	0.35
1989	4649	6223	3472	3118	3471	2800	992	70	0.39	0.46	0.33
1990	7986	10717	5951	2865	3194	2569	1189	57	0.42	0.49	0.35
1991	4952	6597	3717	3152	3527	2816	1107	126	0.40	0.47	0.34
1992	5122	6796	3860	3231	3628	2878	981	77	0.38	0.45	0.32
1993	5006	6659	3763	3057	3416	2735	928	56	0.41	0.48	0.35
1994	4260	5658	3207	2840	3164	2548	1009	52	0.45	0.53	0.39
1995	3697	4934	2770	2759	3070	2480	1157	50	0.50	0.59	0.43
1996	4425	5906	3316	2478	2756	2227	995	47	0.50	0.59	0.43
1997	6022	8027	4518	2197	2451	1968	927	46	0.51	0.60	0.44
1998	7254	9839	5348	2394	2679	2140	875	43	0.48	0.56	0.41
1999	14120	18935	10529	2621	2942	2334	1012	89	0.42	0.49	0.36
2000	9848	13099	7403	2862	3216	2547	1091	158	0.36	0.43	0.30
2001	5242	7007	3922	4376	4972	3852	1168	101	0.36	0.42	0.30
2002	6812	9069	5116	4496	5104	3961	1345	58	0.37	0.44	0.32
2003	5182	6901	3892	4169	4699	3699	1547	54	0.41	0.48	0.35
2004	4680	6188	3540	4027	4502	3603	1391	140	0.43	0.50	0.36
2005	4201	5530	3191	3663	4078	3290	1263	23	0.41	0.48	0.35
2006	3466	4578	2624	3230	3587	2908	1058	41	0.39	0.46	0.33
2007	3835	5065	2903	2956	3296	2651	1052	36	0.37	0.43	0.31
2008	7752	10391	5783	2942	3310	2614	790	8	0.34	0.40	0.28
2009	7004	9226	5317	3093	3533	2708	772	30	0.32	0.38	0.27
2010	3055	4087	2283	3341	3754	2973	867	56	0.31	0.37	0.26
2011	5478	7223	4155	3561	3998	3172	1027	28	0.32	0.38	0.27
2012	6619	8712	5029	3485	3924	3094	1101	32	0.35	0.41	0.29

Year	Recruitment age 1			SSB			Landings **	Discards ***	Fishing mortality ages 3–8		
	Value	High	Low	Value	High	Low			Value	High	Low
2013	5261	6973	3969	3418	3838	3044	1093	26	0.35	0.42	0.29
2014	3903	5218	2919	3639	4133	3204	1041	27	0.35	0.43	0.29
2015	8192	10881	6168	3503	4014	3058	831	17	0.31	0.39	0.25
2016	7601	10193	5669	3627	4150	3170	832	31	0.28	0.35	0.22
2017	14496	19722	10655	3975	4570	3458	778	65	0.25	0.32	0.195
2018	7045	11493	4319	4931	5681	4279	850	141	0.24	0.31	0.181
2019	10317	19733	5394	5546	6541	4702	1068	145	0.24	0.32	0.180
2020	5187 *	14120	3456	6293	7907	5044					

* Median resampled recruitment (1971–2017) as estimated by a stochastic projection.
** Landings are ICES estimates.
*** ICES discard estimates only available from 2004 to 2019. Discards prior to 2004 are calculated using a discard rate-at-age based on 2004–2018 discard data.

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