

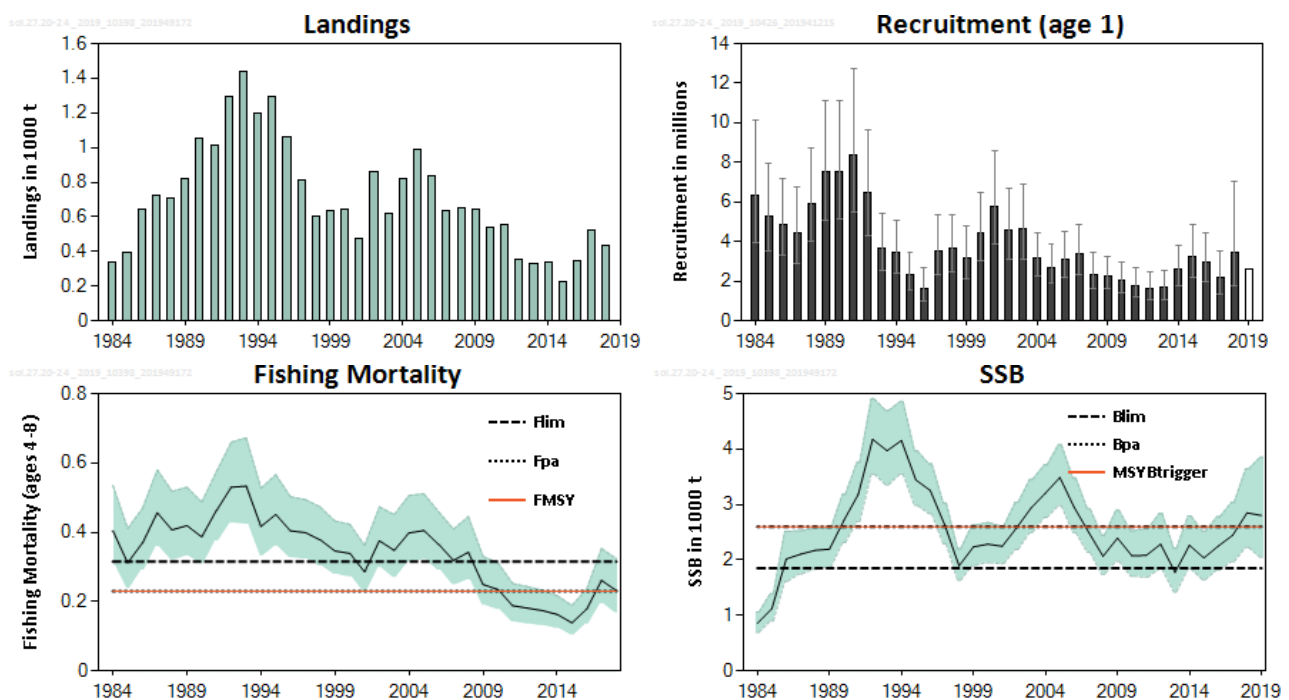
## Sole (*Solea solea*) in subdivisions 20–24 (Skagerrak and Kattegat, western Baltic Sea)

### ICES advice on fishing opportunities

ICES advises that when the EU multiannual plan (MAP) is applied, catches in 2020 that correspond to F ranges in the plan are between 452 tonnes and 600 tonnes. According to the MAP, catches higher than those corresponding to  $F_{MSY}$  (539 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) shows an increasing trend from 2015 and has been above  $MSY B_{trigger}$  in the past two years. Fishing mortality (F) has increased in recent years and is at  $F_{MSY}$  in 2018. Recruitment has fluctuated below the average of the time-series since 2004.



**Figure 1** Sole in subdivisions 20–24. Summary of the stock assessment (weights in thousand tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Assumed recruitment value is unshaded.

### Stock and exploitation status

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

**Table 1** Sole in subdivisions 22–24. State of the stock and fishery relative to reference points.

	Fishing pressure			Stock size			
	2016	2017	2018	2017	2018	2019	
Maximum sustainable yield	$F_{MSY}$	✓	✗	✓	At		
Precautionary approach	$F_{pa}, F_{lim}$	✓	○	✓	Harvested sustainably		
Management plan	$F_{ranges}$	✓	✓	✓	Within range		
				$MSY B_{trigger}$	✗	✓	✓ Above trigger
				$B_{pa}, B_{lim}$	○	✓	✓ Full reproductive capacity
				$B_{MGT}$	✗	✓	✓ Above trigger

**Catch scenarios**

**Table 2** Sole in subdivisions 20–24. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
F <sub>ages 4-8</sub> (2019)	0.23	F corresponding to a TAC of 502 tonnes in 2019.
SSB (2020)	3065 tonnes	Fishing at F = 0.23 in 2019.
R <sub>age 1</sub> (2019-2020)	2618 thousands	Resampled from recruitment (2004–2018).
Wanted catch (2019)	482 tonnes	Based on the TAC and mean discard ratio.
Unwanted catch (2019)	20 tonnes	Mean discard ratio in weight (2014–2018) of 4%.
Total catch (2019)	502 tonnes	Corresponding to a TAC of 502 tonnes.

**Table 3** Sole in subdivisions 20–24. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch * (2020)	Wanted catch ** (2020)	Unwanted catch ** (2020)	F wanted (4–8) (2020)	SSB (2021)	% SSB change ***	% TAC change ^	% Advice change ^^
ICES advice basis								
EU MAP#: F <sub>MSY</sub>	539	518	21	0.23	3081	1%	7.4%	7.4%
EU MAP#: F <sub>lower</sub>	452	435	17	0.19	3168	3%	7.1% #	7.1% #
EU MAP#: F <sub>upper</sub>	600	577	23	0.26	3019	-2%	6.8% ##	6.8% ##
Other scenarios								
F = 0	0	0	0	0	3631	18%	-100%	-100%
F <sub>pa</sub>	539	518	21	0.23	3081	1%	7.4%	7.4%
F <sub>lim</sub>	710	683	27	0.315	2902	-5%	41.4%	41.4%
SSB (2021) = B <sub>lim</sub>	1758	1690	68	1.07	1848	-40%	250.2%	250.2%
SSB (2021) = B <sub>pa</sub>	1015	976	39	0.49	2620	-15%	102.2%	102.2%
SSB (2021) = MSY B <sub>trigger</sub>	1015	976	39	0.49	2620	-15%	102.2%	102.2%
F = F <sub>2019</sub>	539	518	21	0.23	3081	1%	7.4%	7.4%

# EU multiannual plan (MAP) for the North Sea (EU, 2018).

\* Total catch is calculated based on wanted catch (fish that would be landed in the absence of the EU landing obligation) and 4% discard ratio (in weight).

\*\* “Wanted” and “unwanted” catch are used to describe fish that would be landed and discarded in the absence of the EU landing obligation, based on discard ratio estimates for 2014–2018.

\*\*\* SSB 2021 relative to SSB 2020.

^ Total catch in 2020 relative to TAC in 2019 (502 tonnes).

^^ Advice value 2020 relative to advice value 2019 (502 tonnes).

# ICES advice for F<sub>lower</sub> in 2020 relative to ICES advice F<sub>lower</sub> in 2019 (422 tonnes).

## ICES advice for F<sub>upper</sub> in 2020 relative to ICES advice F<sub>upper</sub> in 2019 (562 tonnes).

The advised catch for 2020 represents an increase from previous advice (+7.4%) because of increased recruitment.

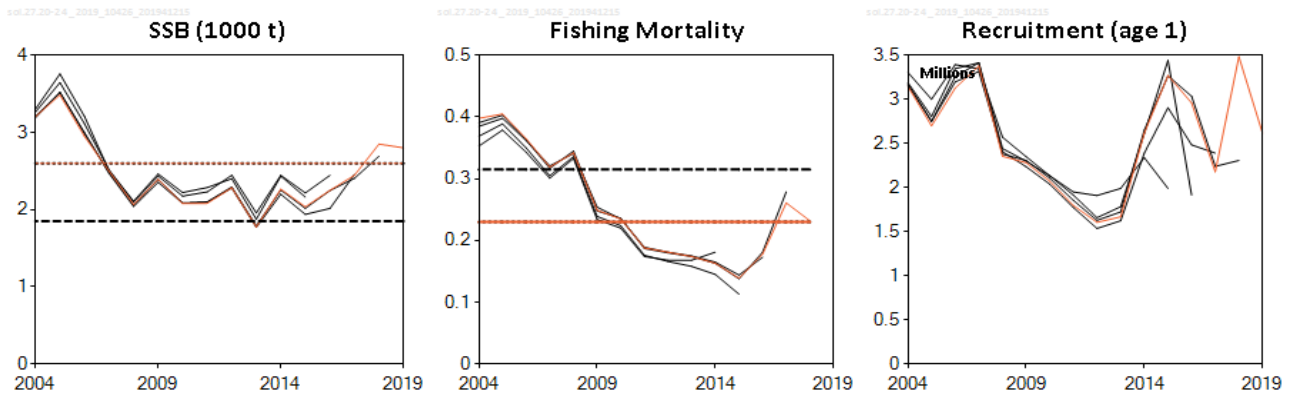
**Basis of the advice**

**Table 4** Sole in subdivisions 20–24. The basis of the advice.

Advice basis	EU multiannual plan (MAP) for stocks in the North Sea (EU, 2018).
Management plan	<p>The EU multiannual plan (MAP) for stocks in North Sea and adjacent waters applies to this stock. The plan specifies conditions for setting fishing opportunities depending on stock status and making use of the <math>F_{MSY}</math> range for the stock.</p> <p>In accordance with the MAP, catches higher than those corresponding to <math>F_{MSY}</math> can only be taken providing SSB is greater than <math>MSY B_{trigger}</math>, and one of the following conditions is met:</p> <ul style="list-style-type: none"> <li>a) if it is necessary for the achievement of objectives of mixed fisheries;</li> <li>b) if is necessary to avoid serious harm to a stock caused by intra- or inter-species stock dynamics;</li> <li>c) in order to limit variations in fishing opportunities between consecutive years to not more than 20 %.</li> </ul> <p>ICES considers that the <math>F_{MSY}</math> range for this stock used in the MAP is precautionary.</p> <p>"</p>

**Quality of the assessment**

This assessment is considered to be internally consistent and of good quality. The number of biological samples has increased significantly in 2018.



**Figure 2** Sole in subdivisions 20–24. Historical assessment results (final-year recruitment estimates included).

**Issues relevant for the advice**

There are no specific issues relevant for this stock.

**Reference points**

**Table 5** Sole in subdivisions 20–24. Reference points, values, and their technical basis. Weights are in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	$MSY B_{trigger}$	2600	$B_{pa}$ .	ICES (2015a)
	$F_{MSY}$	0.23	Equilibrium scenarios stochastic recruitment, short time-series 1992–2014, constrained by $F_{pa}$ .	ICES (2015a)
Precautionary approach	$B_{lim}$	1850	$B_{loss}$ from 1992 (low productivity regime).	ICES (2015a)
	$B_{pa}$	2600	$B_{lim} \times e^{1.645\sigma}$ , $\sigma = 0.20$ .	ICES (2015a)
	$F_{lim}$	0.315	Equilibrium scenarios $prob(SSB < B_{lim}) = 50\%$ with stochastic recruitment.	ICES (2015a)
	$F_{pa}$	0.23	$F_{lim} \times e^{-1.645\sigma}$ , $\sigma = 0.18$ .	ICES (2015a)
Management plan*	MAP $B_{MGT}$	2600	$MSY B_{trigger}$ .	ICES (2015a)
	MAP $B_{lim}$	1850	$B_{lim}$ .	ICES (2015a)
	MAP $F_{MSY}$	0.23	$F_{MSY}$ .	ICES (2015a)
	MAP range $F_{lower}$	0.19	$F_{MSY lower}$ without AR from equilibrium scenarios.	ICES (2015b)
	MAP range $F_{upper}$	0.26	$F_{p05}$ with AR from equilibrium scenarios.	ICES (2015b)

\* EU multiannual plan (MAP) for the North Sea (EU, 2018).

## Basis of the assessment

**Table 6** Sole in subdivisions 20–24. Basis of the assessment and advice.

ICES stock data category	1 ( <a href="#">ICES, 2018</a> ).
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included afterwards in the forecast (ICES, 2019).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua 2004–2018), two commercial indices: (private logbook gillnetters (1994–2007), private logbook trawlers (1987–2008)); fixed maturity and fixed natural mortality (0.1) for all age groups.
Discards and bycatch	Used to provide advice, but not included in the assessment. Discard information available since 2000, average discard ratio 2014–2018 is 4%.
Indicators	None.
Other information	Stock inter-benchmarked in 2015 (ICES, 2015a).
Working group	Baltic Fisheries Assessment Working Group ( <a href="#">WGBFAS</a> )

## Information from stakeholders

There is no additional available information for this stock.

## History of the advice, catch, and management

**Table 7** Sole in subdivisions 20–24. History of ICES advice, agreed TAC, and ICES estimates of landings and discards. Weights are in tonnes.

Year	ICES advice	Catch corresponding to advice	Landings corresponding to advice	Agreed TAC*	ICES landings**	ICES discards***
1987	-	-	-	850	722	-
1988	-	-	-	950	706	-
1989	TAC	-	< 800	800	824	-
1990	Precautionary TAC	-	600	500	1050	-
1991	TAC	-	1000	1000	- <sup>^</sup>	-
1992	TAC	-	1000	1400	- <sup>^</sup>	-
1993	TAC at recent catch levels	-	1000	1600	- <sup>^</sup>	-
1994	No advice due to uncertain catches	-	-	2100	1198	-
1995	No advice	-	-	2250	1297	-
1996	No advice	-	-	2250	1059	-
1997	No advice	-	-	2250	814	-
1998	No advice	-	-	1800	605	-
1999	No increase in F	-	800	1350	637	-
2000	No increase in F	-	650	950	645	169
2001	No increase in F	-	700	700	478	-
2002	F below $F_{pa}$	-	500	500	862	10
2003	F below $F_{pa}$	-	300	350	618	43
2004	F below $F_{pa}$	-	500	520	824	-
2005	No increase in F	-	850	900	990	-
2006	F below $F_{pa}$	-	820	900	836	-
2007	Limit catches to 2002–2005 average	-	740	900	633	-
2008	F below $F_{pa}$	-	970	940	655	-
2009	F below $F_{pa}$	-	800	800	641	-

Year	ICES advice	Catch corresponding to advice	Landings corresponding to advice	Agreed TAC*	ICES landings**	ICES discards***
2010	F below $F_{pa}$	-	620	700	538	14
2011	See scenarios	-	-	840	552	8
2012	MSY framework	-	610	0.61^^	358	11
2013	MSY framework	-	560	590	332	10
2014	MSY approach	353	353^^^	350	335	32
2015	MSY approach	211	205	205	224	6
2016	MSY approach	≤ 394	379	391	348	17
2017	MSY approach	≤ 555	-	555	520	15
2018	MSY approach	≤ 453	-	448	434	7
2019	Proposed MAP F ranges, $F_{lower}$ to $F_{upper}$	422–562		502		
2020	MAP target F ranges: $F_{lower}$ to $F_{upper}$ , but F higher than $F_{MSY}$ only under conditions specified in MAP	452–600, but catch higher than 539 only under conditions specified in MAP				

\* TAC applies to subdivisions 20–21 and the EC waters of subdivisions 22–32.

\*\* Landings include subdivisions 20–21 and subdivisions 22–24.

\*\*\* Discard estimates are not available for all years.

^ Uncertain.

^^ No more than 461 tonnes in subdivisions 20–21.

^^^ Discarding assumed to be negligible.

### History of the catch and landings

**Table 8** Sole in subdivisions 20–24. Catch distribution by fleet in 2018 as estimated by ICES.

Catch (2018)	Landings		Discards
441 tonnes	Active gears 65%	Passive gears 35%	7 tonnes
	434 tonnes		

**Table 9** Sole in subdivisions 20–24. History of landings by country and area. Weights are in tonnes.

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak and Kattegat	Kattegat and the Belts	Skagerrak	Skagerrak	Skagerrak		
1952	156			51	59				266	266
1953	159			48	42				249	249
1954	177			43	34				254	254
1955	152			36	35				223	223
1956	168			30	57				255	255
1957	265			29	53				347	347
1958	226			35	56				317	317
1959	222			30	44				296	296
1960	294			24	83				401	401
1961	339			30	61				430	430
1962	356				58				414	414
1963	338				27				365	365
1964	376				45				421	421
1965	324				50				374	374
1966	312				20				332	332
1967	429				26				455	455
1968	290				16				306	306
1969	261				7				268	268
1970	158	25							183	183
1971	242	32			9				283	283
1972	327	31			12				370	370
1973	260	52			13				325	325
1974	388	39			9				436	436
1975	381	55		16	16		9		477	468
1976	367	34		11	21	2	155		590	435
1977	400	91		13	8	1	276		789	513
1978	336	141		9	9		141		636	495
1979	301	57		8	6	1	84		457	373
1980	228	73		9	12	2	5		329	324
1981	199	59		7	16	1			282	282
1982	147	52		4	8	1	1		213	212
1983	180	70		11	15		31		307	276
1984	235	76		13	13		54		391	337
1985	275	102		19	1	+	132		529	397
1986	456	158		26	1	2	109		752	643
1987	564	137		19		2	70		792	722
1988	540	138		24		4			706	706
1989	578	217		21	7	1			824	824
1990	464	128		29		2			623	1050
1991	746	216		38	+				1000	1011
1992	856	372		54					1282	1294
1993	1016	355		68	9				1448	1439
1994	890	296		12	4				1202	1198
1995	850	382		65	6				1303	1297
1996	784	203		57	612				1656	1059
1997	560	200		52	2				814	814

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak and Kattegat	Kattegat and the Belts	Skagerrak	Skagerrak	Skagerrak		
1998	367	145		90	3				605	605
1999	431	158		45	3				637	637
2000	399	320	13	34	11				777	645
2001	249	286	21	25					581	478
2002*	360	177	18	15	11				581	862
2003*	195	77	17	11	17				317	618
2004*	249	109	40	16	18				432	824
2005*	531	132	118	30	34				845	990
2006	521	114	107	38	43		4	9	836	836
2007	366	81	93	45	39		0	9	633	633
2008	361	102	113	34	35		3	7	655	655
2009	325	103	145	37	27			4	641	641
2010	273	61	125	46	26		3	3	537	538
2011	271	127	65	53	33			3	552	552
2012	154	140	28	30				6	358	358
2013	153	78		54	9			6	300	332
2014	141	104	48	36	2		0.3	3	335	335
2015	95	66	36	9	7		6	5	224	224
2016	164	78	56	14	17		16	2	348	348
2017	221	169	47	20	22		41	2	520	520
2018	158	140	57	16	15		47	0	434	434

\* Assuming misreporting rates at 50%, 100%, 100%, and 20% in 2002–2005, respectively.

## Summary of the assessment

**Table 10** Sole in subdivisions 20–24. Assessment summary. Weights are in tonnes, recruitment in thousands. High and low refers to 95% confidence intervals.

Year	Recruitment			SSB			Landings tonnes	Fishing mortality		
	Age 1	High	Low	SSB	High	Low		Ages 4–8	High	Low
	thousands			tonnes						
1984	6328	10098	3965	859	1062	696	337	0.40	0.54	0.31
1985	5294	7944	3528	1123	1395	903	397	0.31	0.41	0.24
1986	4878	7197	3307	2018	2514	1619	643	0.37	0.47	0.29
1987	4410	6726	2891	2104	2529	1751	722	0.46	0.58	0.36
1988	5891	8705	3987	2173	2572	1835	706	0.41	0.52	0.32
1989	7495	11105	5059	2196	2574	1873	824	0.42	0.53	0.33
1990	7555	11133	5127	2712	3181	2313	1050	0.39	0.49	0.31
1991	8378	12726	5515	3183	3758	2696	1011	0.46	0.57	0.37
1992	6456	9637	4326	4175	4905	3553	1294	0.53	0.66	0.43
1993	3687	5426	2505	3970	4694	3357	1439	0.53	0.67	0.42
1994	3469	5071	2373	4155	4856	3554	1198	0.42	0.53	0.33
1995	2295	3442	1531	3442	3968	2985	1297	0.45	0.57	0.36
1996	1628	2682	988	3254	3734	2836	1059	0.40	0.50	0.33
1997	3550	5348	2357	2635	3027	2293	814	0.40	0.49	0.32
1998	3649	5338	2495	1896	2200	1633	605	0.38	0.47	0.30
1999	3183	4754	2131	2236	2628	1902	637	0.35	0.43	0.28
2000	4437	6481	3038	2284	2672	1953	645	0.34	0.42	0.27
2001	5780	8596	3886	2247	2611	1934	478	0.29	0.36	0.23
2002	4574	6701	3122	2582	3040	2192	862	0.38	0.47	0.30
2003	4628	6869	3119	2938	3453	2499	618	0.35	0.45	0.27
2004	3150	4451	2230	3205	3712	2767	824	0.40	0.51	0.31
2005	2701	3844	1897	3487	4079	2981	990	0.41	0.51	0.32
2006	3128	4514	2167	2949	3479	2500	836	0.37	0.46	0.29
2007	3381	4845	2360	2499	2921	2137	633	0.32	0.41	0.25
2008	2356	3426	1620	2067	2449	1744	655	0.34	0.45	0.26
2009	2283	3273	1592	2394	2898	1977	641	0.25	0.33	0.189
2010	2073	2985	1440	2078	2527	1709	538	0.24	0.31	0.177
2011	1797	2651	1218	2082	2562	1691	552	0.188	0.25	0.141
2012	1606	2440	1057	2284	2838	1839	358	0.181	0.24	0.135
2013	1668	2537	1096	1776	2210	1427	332	0.174	0.23	0.130
2014	2618	3808	1800	2266	2794	1837	335	0.163	0.22	0.122
2015	3272	4870	2199	2037	2519	1647	224	0.139	0.189	0.103
2016	2960	4409	1988	2250	2779	1822	348	0.178	0.24	0.135
2017	2179	3510	1353	2446	3034	1972	520	0.26	0.35	0.193
2018	3485	7011	1732	2850	3643	2229	434	0.23	0.32	0.167
2019	2618*			2802	3853	2050				

\* Resampled from recent recruitment (2004–2018).

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