

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

ICES advice on fishing opportunities

ICES advises that when the proposed EU multiannual plan (MAP) is applied, catches in 2019 that correspond to F ranges in the plan are between 422 tonnes and 562 tonnes. According to the MAP, catches higher than those corresponding to F_{MSY} (502 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 fluctuating close to B_{lim} since 2008 but has in the past three years increased and is now above $MSY B_{trigger}$. Fishing mortality (F) has increased above F_{msy} in 2017. The recruitment since 2004 is estimated to be below the average of the time-series.

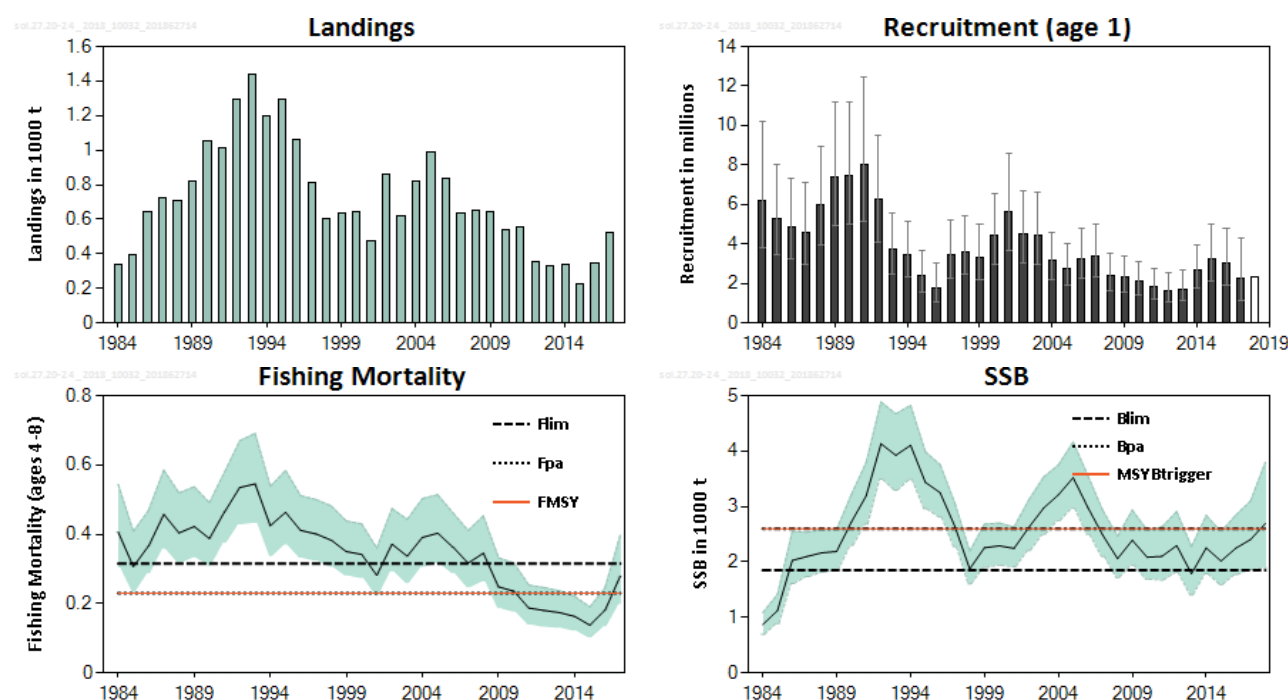


Figure 1 Sole in subdivisions 20–24. Summary of the stock assessment (weights in thousand tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Predicted values are unshaded.

Stock and exploitation status

ICES assesses that fishing pressure on the stock is above F_{MSY} and F_{pa} but 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		
		2015	2016	2017	2016	2017	2018
Maximum sustainable yield	F_{MSY}	✓	✓	✗	✗	✗	✓ Above trigger
Precautionary approach	F_{pa}, F_{lim}	✓	✓	⚠	⚠	⚠	✓ Full reproductive capacity
Management plan	F_{MGT}	✓	✓	✗	✗	✗	✓ Above

Catch scenarios

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

Variable	Value	Notes
$F_{\text{ages 4-8}}$ (2018)	0.22	F corresponding to a TAC of 448 t in 2018
SSB (2019)	2746 tonnes	Fishing at $F = 0.22$ in 2018
R_{age1} (2018)	2308 thousands	Resampled from recent recruitment (2013–2017)
R_{age1} (2019)	2241 thousands	Resampled from recent recruitment (2013–2017)
Wanted catch (2018)	431 tonnes	Based on the TAC and mean discard rate
Unwanted catch (2018)	17 tonnes	Mean discard rate in weight (2013–2017) of 4%.
Total catch (2018)	448 tonnes	Corresponding to a TAC of 448 t.

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

Basis	Total catch (2019) *	Wanted catch (2019) **	Unwanted catch (2019) **	F_{wanted} (2019)	SSB (2020)	% SSB change ***	% TAC change ^	% Advice change ^^
ICES advice basis								
EU MAP#: F_{MSY}	502	483	19	0.23	2707	-1%	8%	11%
EU MAP#: F_{lower}	422	406	16	0.19	2793	2%	-9%	-7%
EU MAP#: F_{upper}	562	540	22	0.26	2659	-3%	21%	24%
Other scenarios								
$F = 0$	0	0	0	0	3226	17%	-100%	-100%
F_{pa}	502	483	19	0.23	2707	-1%	8%	11%
F_{lim}	662	637	25	0.315	2564	-7%	42%	46%
SSB (2020) = B_{lim}	1359	1307	52	0.79	1843	-33%	192%	200%
SSB (2020) = B_{pa}	575	553	22	0.27	2611	-5%	23%	27%
SSB (2020) = $\text{MSY } B_{\text{trigger}}$	575	553	22	0.27	2611	-5%	23%	27%
$F = F_{2018}$	493	474	19	0.22	2715	-1%	6%	9%

Proposed EU multiannual plan (MAP) for the North Sea (EU 2016)

* Total catch is calculated based on wanted catch (fish that would be landed in the absence of the EU landing obligation) and 4% discard rate (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 rate estimates for 2013–2017.

*** SSB 2020 relative to SSB 2019.

^ Wanted catch in 2019 relative to TAC in 2018 (448 t).

^^ Advice value 2019 relative to advice value 2018 (453 t).

The advised catch for 2019 represents an increase from previous advice due to an increase in SSB.

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.
Management plan	The proposed EU multiannual plan (MAP) for stocks in the North Sea includes sole in subdivisions 20–24 (EU 2016). The advice is based on F_{MSY} ranges used in the MAP and is considered precautionary.

Quality of the assessment

Sufficient biological sampling of landings is difficult to obtain from the mixed fisheries, where sole is caught as a valuable bycatch. This is due to the low total sole landings that are spatially dispersed.

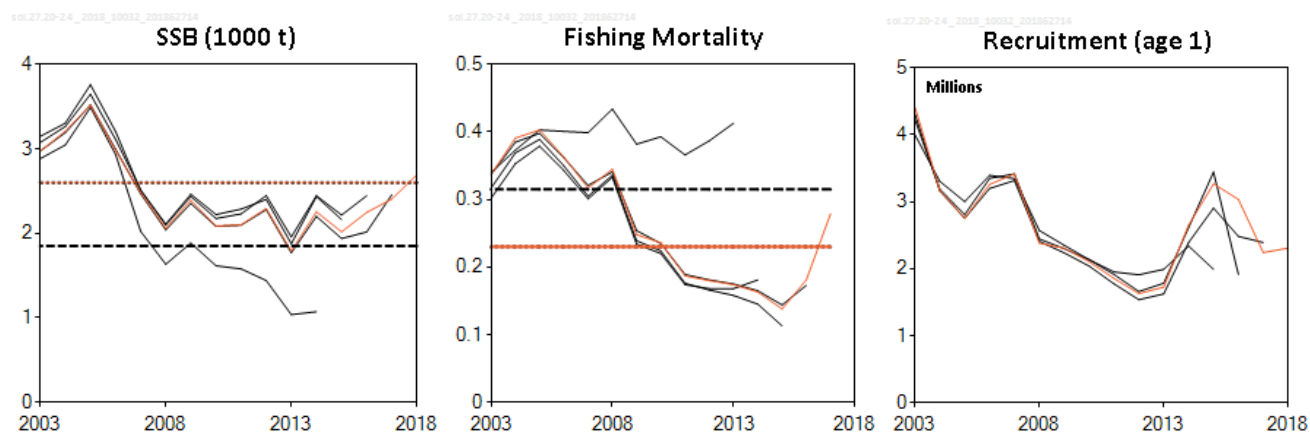


Figure 2 Sole in subdivisions 20–24. Historical assessment results (final-year recruitment estimates included). Recruitment age in the assessment has changed from two to one following the inter-benchmark in 2015 (ICES, 2015).

Issues relevant for the advice

The advice is based on the range of F_{MSY} (F_{lower} - F_{upper}) according to the proposed EU multiannual plan (MAP).

Reference points

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

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	2600 t	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 t	B_{loss} from 1992 (low productivity regime).	ICES (2015a)
	B_{pa}	2600 t	$B_{lim} \times e^{1.645\sigma}$, $\sigma = 0.20$	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 t	MSY $B_{trigger}$	
	MAP B_{lim}	1850 t	B_{lim}	
	MAP F_{MSY}	0.23	F_{MSY}	
	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)

*Proposed EU multiannual plan (MAP) for the North Sea (EU 2016)

Basis of the assessment

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

ICES stock data category	1 (ICES, 2016).
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included afterwards in the forecast (ICES, 2018).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua 2004–2017), 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 rates 2013–2017 are 4%.
Indicators	None.
Other information	Stock inter-benchmarked in 2015 (ICES, 2015).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

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	- [^]	-
1992	TAC	-	1000	1400	- [^]	-
1993	TAC at recent catch levels	-	1000	1600	- [^]	-
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	-
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		
2019	Proposed MAP F ranges, F_{lower} to F_{upper}	422–562				

* 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 t 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 2017 as estimated by ICES.

Catch (2017)	Landings		Discards
	Active gears 60%	Passive gears 40%	
535 tonnes	520 tonnes		15 tonnes

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

Year	Denmark			Sweden Skagerrak + Kattegat	Germany Kattegat+Belts	Belgium Skagerrak	Netherlands Skagerrak	Norway Skagerrak	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts							
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

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak + Kattegat	Kattegat+Belts	Skagerrak	Skagerrak	Skagerrak		
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
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

* Considerable non-reporting assumed for the period 1991–1993.

** 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	High	Low	SSB	High	Low	Landings	Fishing Mortality	High	Low
	Age 1							Ages 4-8		
1984	6204	10172	3784	870	1086	696	337	0.41	0.54	0.30
1985	5258	8029	3443	1124	1415	892	397	0.31	0.41	0.23
1986	4888	7331	3259	2027	2550	1611	643	0.37	0.47	0.28
1987	4595	7104	2972	2099	2536	1736	722	0.46	0.59	0.36
1988	5949	8914	3971	2165	2582	1815	706	0.40	0.52	0.32
1989	7415	11177	4920	2189	2585	1854	824	0.42	0.54	0.33
1990	7463	11188	4978	2721	3217	2302	1050	0.39	0.49	0.31
1991	8026	12476	5163	3192	3795	2685	1011	0.47	0.58	0.37
1992	6237	9477	4105	4132	4885	3495	1294	0.54	0.67	0.43
1993	3735	5593	2494	3924	4671	3296	1439	0.55	0.69	0.43
1994	3466	5143	2335	4104	4825	3491	1198	0.43	0.54	0.34
1995	2388	3671	1553	3436	3987	2962	1297	0.46	0.58	0.37
1996	1763	3004	1035	3250	3754	2813	1059	0.41	0.51	0.33
1997	3420	5189	2255	2640	3057	2280	814	0.40	0.50	0.32
1998	3627	5397	2437	1876	2192	1606	605	0.38	0.48	0.30
1999	3284	4979	2166	2257	2681	1900	637	0.35	0.44	0.28
2000	4418	6567	2973	2291	2702	1942	645	0.34	0.43	0.27
2001	5636	8608	3690	2245	2632	1914	478	0.28	0.36	0.22
2002	4481	6675	3008	2624	3119	2208	862	0.37	0.47	0.29
2003	4419	6644	2939	2972	3532	2501	618	0.34	0.44	0.26
2004	3173	4553	2211	3210	3750	2747	824	0.39	0.50	0.30
2005	2752	3997	1895	3519	4162	2976	990	0.40	0.51	0.32
2006	3259	4762	2230	2982	3553	2502	836	0.36	0.46	0.29
2007	3416	4978	2344	2483	2930	2104	633	0.32	0.41	0.25
2008	2381	3523	1609	2061	2467	1721	655	0.35	0.45	0.26
2009	2308	3354	1588	2391	2934	1948	641	0.25	0.33	0.185
2010	2106	3075	1443	2086	2573	1691	538	0.24	0.32	0.175
2011	1855	2781	1238	2101	2632	1678	552	0.187	0.25	0.138
2012	1629	2560	1036	2295	2909	1811	358	0.180	0.25	0.131
2013	1724	2703	1099	1789	2277	1407	332	0.174	0.24	0.128
2014	2651	3944	1781	2254	2838	1791	335	0.163	0.22	0.120
2015	3268	5018	2128	2017	2549	1596	224	0.138	0.190	0.100
2016	3036	4783	1926	2248	2845	1776	348	0.181	0.25	0.133
2017	2241	4318	1163	2406	3101	1866	520	0.28	0.40	0.197
2018	2308*			2693	3799	1895				

* Resampled from recent recruitment (2013-2017).

Sources and references

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