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) for the North Sea and adjacent waters is applied, catches in 2022 that correspond to the F ranges in the plan are between 544 tonnes and 723 tonnes. The entire range is considered precautionary when applying ICES advice rule.

Stock development over time

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

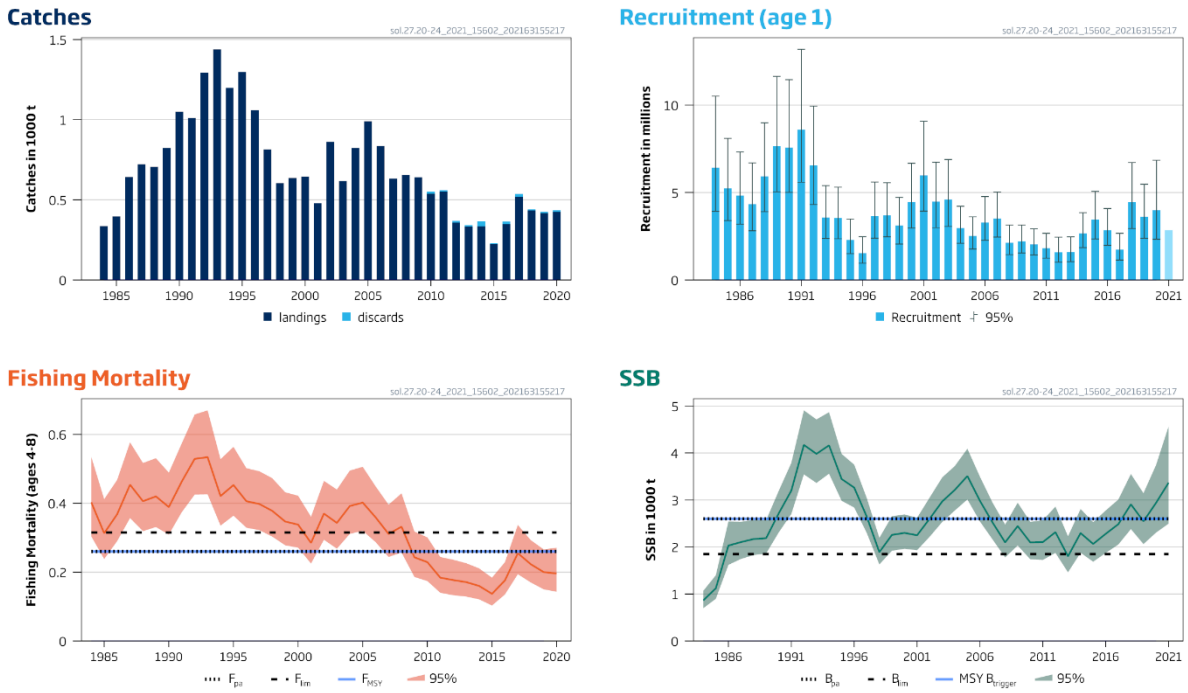

Figure 1 Sole in subdivisions 20–24. Summary of the stock assessment. The assumed recruitment value for 2021 is shaded in a lighter colour.

Catch scenarios

Table 1 Sole in subdivisions 20–24. Values in the forecast and for the interim year..

Variable	Value	Notes
$F_{ages\ 4–8}$ (2021)	0.196	F_{sq} (=F_{2020})
SSB (2022)	3756	Short-term forecast (STF); tonnes
$R_{age\ 1}$ (2021)	2848	Median recruitment, resampled from 2004–2020; thousands
$R_{age\ 1}$ (2022)	2669	Median recruitment, resampled from 2004–2020; thousands
Projected landings (2021)	503	Based on fishing at F_{sq} and mean discard rate; tonnes
Projected discards (2021)	18	Mean discard rate in weight (2016–2020) of 2.9%; tonnes.
Total catch (2021)	521	STF; tonnes

Table 2 Sole in subdivisions 20–24. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch* (2022)	Projected landings (2022)	Projected discards (2022)	F projected landings (4–8) (2022)	SSB (2023)	% SSB change**	% TAC change^	% advice change^^
ICES advice basis								
EU MAP#: F_{MSY}	723	703	20	0.260	3590	−4.4	21.3	21.3
EU MAP#: F_{lower}	544	529	15	0.190	3773	0.45	−8.7	8.4§
EU MAP#: F_{upper}	723	703	20	0.260	3590	−4.4	21.3	8.7§§
Other scenarios								
F = 0	0	0	0	0	4323	15.1	−100	−100
F_{pa}	723	703	20	0.260	3590	−4.4	21.3	21.3
F_{lim}	856	832	24	0.315	3454	−8.0	44	44
TAC 2021*1.2	715	695	20	0.257	3598	−4.2	20	20
SSB (2023) = B_{lim}	2153	2347	67	1.32	1859	−51	261	261
SSB (2023) = B_{pa}	1680	1633	47	0.74	2617	−30	182	182
SSB (2023) = MSY $B_{trigger}$	1680	1633	47	0.74	2617	−30	182	182
F = F_{2021}	561	545	16	0.196	3756	0.00	−6.0	−6.0

EU multiannual plan (MAP) for the North Sea (EU, 2018).
* Total catch is calculated based on projected landings (fish that would be landed in the absence of the EU landing obligation) and 2.9% discard ratio (in weight).
** SSB 2023 relative to SSB 2022.
^ Total catch in 2022 relative to the TAC in 2021 (596 tonnes in 2021).
^^ Advice value 2022 relative to the advice value 2021 (596 tonnes).
§ ICES advice for F_{lower} in 2022 relative to ICES advice F_{lower} in 2021 (502 tonnes).
§§ ICES advice for F_{upper} in 2022 relative to ICES advice F_{upper} in 2021 (665 tonnes).

The advised catch for 2022 represents an increase from previous advice because of higher recruitment in recent years and an incease in F_{MSY} (from 0.23 to 0.26).

Basis of the advice

Table 3 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	The EU multiannual plan (MAP) for stocks in the 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 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: • if taking the higher catches is necessary for the achievement of mixed fisheries objectives; • if it is necessary to avoid serious harm to a stock caused by intra- or inter-species stock dynamics; • or in order to limit variations in fishing opportunities between consecutive years to no more than 20 %. ICES considers that the F_{MSY} range for this stock used in the MAP is precautionary.

Quality of the assessment

This assessment is considered to be consistent. The number of biological samples has increased to an acceptable level in recent years.

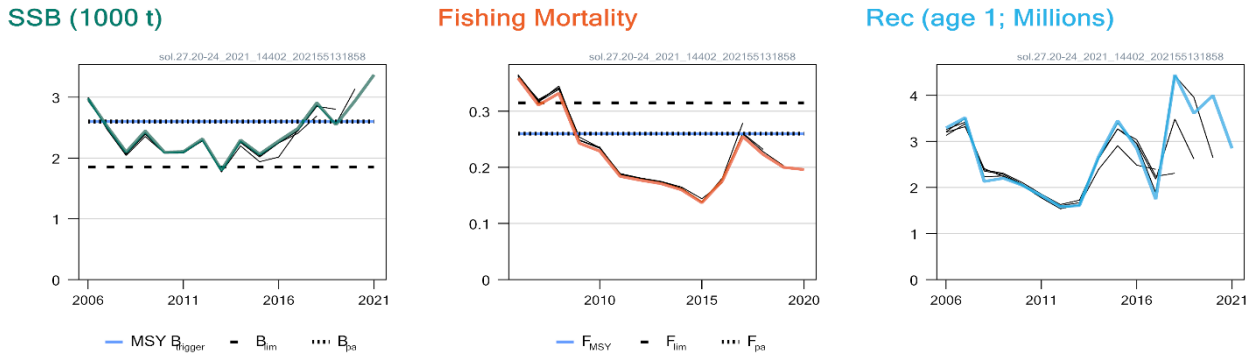

Figure 2 Sole in subdivisions 20–24. Historical assessment results (final-year assumed recruitment estimate included).

Issues relevant for the advice

There are no specific issues relevant for this stock.

Reference points

Table 4 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}	0.26	Equilibrium scenarios, stochastic recruitment, short time-series 1992–2014, previously capped by F_{pa} at 0.23, which is currently estimated at 0.26	ICES (2015a, 2021a)
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}	0.26	F_{P05}. The F that leads to SSB ≥ B_{lim} with 95% probability	ICES (2015a, 2021a)
Management plan*	MAP B_{MGT}	2600	MSY $B_{trigger}$	ICES (2015a)
	MAP B_{lim}	1850	B_{lim}	ICES (2015a)
	MAP F_{MSY}	0.26	F_{MSY}	ICES (2015a, 2021a)
	MAP range F_{lower}	0.19	$F_{MSY\ lower}$ without advice rule (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 5 Sole in subdivisions 20–24. Basis of the assessment and advice.

ICES stock data category	1 (ICES, 2021b)
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included in the forecast (ICES, 2021a).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua sole survey, 2004–2020, [G4052]), 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 2016–2020 is 2.9%.
Indicators	None
Other information	Stock inter-benchmarked in 2015 (ICES, 2015a)
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

History of the advice, catch, and management

Table 6 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	610^^	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	17
2018	MSY approach	≤ 453	-	448	434	7
2019	Proposed MAP F ranges, F_{lower} to F_{upper}	422–562	-	502	419	8

Year	ICES advice	Catch corresponding to advice	Landings corresponding to advice	Agreed TAC*	ICES landings**	ICES discards***
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		533	424	12
2021	Management plan	596 (range 502–665)		596		
2022	Management plan	723 (range 544-723)				

* 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 is assumed to be negligible.

History of the catch and landings

Table 7 Sole in subdivisions 20–24. Catch distribution by fleet in 2020 as estimated by ICES.

Catch (2020)	Landings		Discards
436 tonnes	Active gears 58 %	Passive gears 42 %	12 tonnes
	424 tonnes		

Table 8 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

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		
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
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

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		
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	215	166	46	19	21		31	2	501	520
2018	158	140	57	16	15		47	0	434	434
2019	150	88	82	13	15		69	2	417	417
2020	136	109	85	9	24		60	1	424	424

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

Summary of the assessment

Table 9 Sole in subdivisions 20–24. Assessment summary. Weights are in tonnes, recruitment in thousands. High and Low refer to 95% confidence intervals.

Year	Recruitment			Spawning-stock biomass			Landings	Discards	Fishing mortality		
	R (age 1)	High	Low	SSB	High	Low			F (ages 4–8)	High	Low
	thousands			tonnes			tonnes				
1984	6425	10516	3925	863	1068	697	337		0.40	0.54	0.30
1985	5245	8097	3398	1122	1400	898	397		0.31	0.41	0.24
1986	4833	7325	3189	2030	2543	1620	643		0.37	0.47	0.29
1987	4338	6693	2811	2104	2536	1746	722		0.45	0.58	0.36
1988	5928	8990	3909	2169	2576	1827	706		0.41	0.52	0.32
1989	7658	11642	5038	2188	2571	1862	824		0.42	0.53	0.33
1990	7574	11454	5009	2716	3195	2309	1050		0.39	0.49	0.31
1991	8587	13191	5589	3199	3790	2701	1011		0.46	0.57	0.37
1992	6549	9941	4314	4172	4908	3546	1294		0.53	0.66	0.43
1993	3578	5397	2373	3982	4715	3362	1439		0.53	0.67	0.43
1994	3536	5307	2356	4163	4869	3559	1198		0.42	0.53	0.34
1995	2291	3481	1509	3446	3981	2983	1297		0.45	0.56	0.36
1996	1538	2474	957	3264	3752	2839	1059		0.41	0.50	0.33
1997	3658	5600	2390	2644	3042	2298	814		0.40	0.49	0.32
1998	3705	5560	2469	1890	2195	1628	605		0.38	0.47	0.30
1999	3114	4726	2052	2257	2654	1920	638		0.35	0.43	0.28
2000	4452	6675	2969	2299	2693	1962	646		0.34	0.42	0.27
2001	5981	9084	3937	2250	2621	1931	476		0.28	0.36	0.23
2002	4487	6732	2991	2602	3053	2218	862		0.37	0.47	0.29
2003	4594	6893	3061	2969	3481	2532	619		0.34	0.44	0.27
2004	2970	4211	2095	3215	3723	2776	824		0.39	0.50	0.31
2005	2527	3612	1768	3510	4092	3011	990		0.40	0.51	0.32
2006	3292	4769	2273	2981	3495	2542	836		0.36	0.45	0.29
2007	3515	5034	2455	2522	2944	2160	633		0.31	0.40	0.24
2008	2130	3139	1446	2099	2479	1778	656		0.33	0.43	0.26
2009	2200	3142	1541	2445	2943	2032	640		0.24	0.32	0.186
2010	2046	2927	1430	2098	2535	1737	541	14	0.23	0.30	0.174

Year	Recruitment			Spawning-stock biomass			Landings	Discards	Fishing mortality		
	R (age 1)	High	Low	SSB	High	Low			F (ages 4–8)	High	Low
	thousands			tonnes			tonnes				
2011	1823	2666	1247	2105	2570	1724	507	8	0.184	0.24	0.140
2012	1581	2451	1020	2315	2859	1874	358	11	0.177	0.24	0.133
2013	1607	2466	1047	1803	2227	1460	332	10	0.171	0.23	0.129
2014	2669	3847	1852	2296	2809	1877	331	32	0.160	0.21	0.121
2015	3450	5070	2348	2065	2530	1686	215	6	0.137	0.184	0.103
2016	2848	4089	1983	2281	2778	1873	348	17	0.176	0.23	0.135
2017	1745	2667	1142	2485	3010	2052	520	17	0.26	0.34	0.194
2018	4445	6720	2940	2908	3553	2381	434	7	0.22	0.29	0.170
2019	3609	5475	2379	2547	3146	2062	417	8	0.20	0.27	0.150
2020	3996	6847	2332	2939	3745	2306	424	12	0.196	0.27	0.143
2021	2848*			3369	4570	2497					

* Resampled from recruitment in 2004–2020.

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Download the stock assessment data and figures.

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