

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 2023 that correspond to the F ranges in the plan are between 380 tonnes and 504 tonnes.

Stock development over time

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

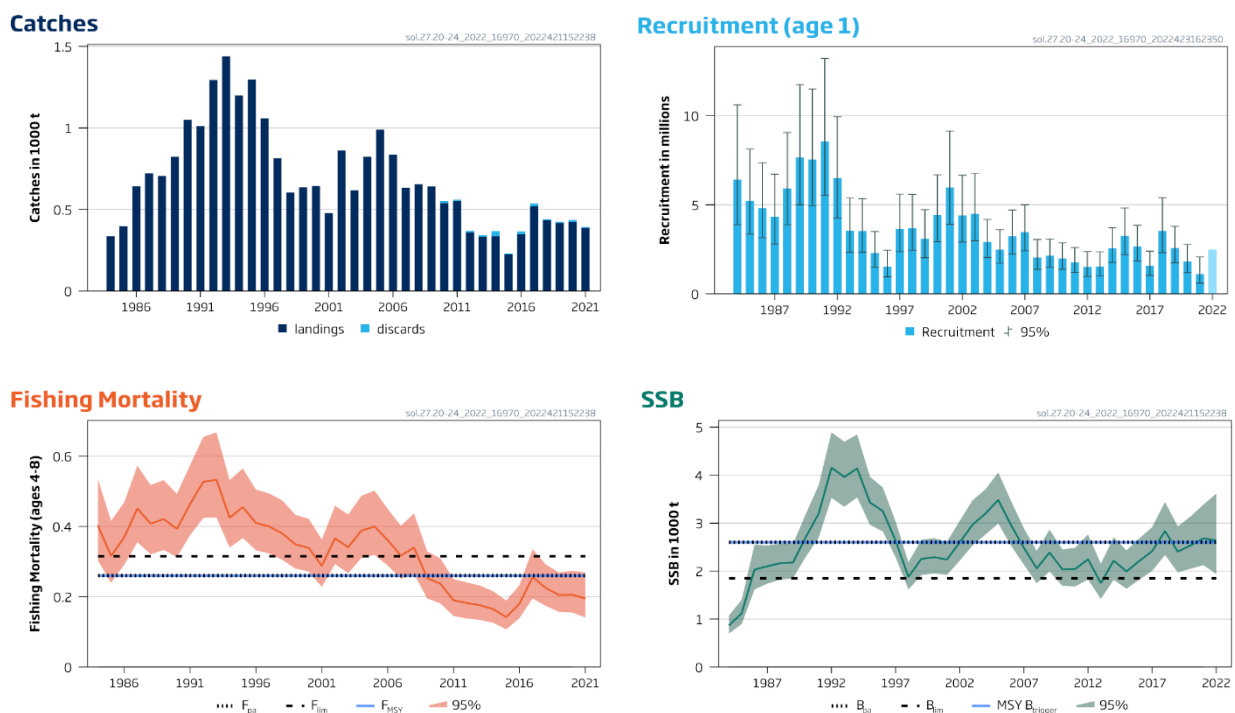


Figure 1 Sole in subdivisions 20–24. Summary of the stock assessment. The assumed recruitment value for 2022 is shaded in a lighter colour.

Catch scenarios

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

Variable	Value	Notes
$F_{ages\ 4-8}$ (2022)	0.195	$F_{sq} = F_{2021}$
SSB (2023)	2 441	Short-term forecast (STF); tonnes
$R_{age\ 1}$ (2022–23)	2 485	Median recruitment, resampled from 2004–2021; thousands
Projected landings (2022)	409	Based on fishing at F_{sq} and mean discard rate; tonnes
Projected discards (2022)	9	Mean discard rate in weight (2017–2021) of 2.3%; tonnes
Total catch (2022)	418	STF; tonnes

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

Basis	Total catch* (2023)	Projected landings (2023)	Projected discards (2023)	F projected landings (4–8) (2023)	SSB (2024)	% SSB change**	% TAC change^	% advice change^^
ICES advice basis								

Basis	Total catch* (2023)	Projected landings (2023)	Projected discards (2023)	F projected landings (4–8) (2023)	SSB (2024)	% SSB change**	% TAC change^	% advice change^^
EU MAP#: F_{MSY} * $SSB_{2023}/MSY B_{trigger}$	504	493	11	0.244	2 403	–1.6	–29.5	–30.3
EU MAP#: F_{lower} * $SSB_{2023}/MSY B_{trigger}$	380	372	8	0.178	2 527	3.5	–43.5	–25.7 [§]
Other scenarios								
$F = 0$	0	0	0	0	2 920	19.6	–100.0	–100.0
F_{pa}, F_{MSY}	534	522	12	0.26	2 373	–2.8	–25.3	–26.2
F_{lim}	628	614	14	0.315	2 271	–7.0	–12.2	–13.1
$SSB (2024) = B_{lim}$	1 031	1 008	23	0.585	1 850	–24.2	44.2	42.6
$SSB (2024) = B_{pa}$	306	299	7	0.14	2 600	6.5	–57.2	–57.7
$SSB (2024) =$ $MSY B_{trigger}$	306	299	7	0.14	2 600	6.5	–57.2	–57.7
$F = F_{2022}$	413	404	9	0.195	2 494*	2.2*	–42.2	–42.9

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

* Total catch is calculated based on projected landings and assuming 2.3% discard ratio (in weight).

** SSB 2024 relative to SSB 2023.

^ Total catch in 2023 relative to the TAC in 2022 (715 tonnes in 2022).

^^ Advice value 2023 relative to the advice value 2022 (723 tonnes).

§ ICES advice for F_{lower} in 2023 relative to ICES advice F_{lower} in 2022 (544 tonnes).

The advised catch for 2023 represents a decrease from previous advice because of a lower SSB estimated for 2020–2021 than estimated last year and due to low incoming recruitment. In addition, since the expected SSB in 2023 is below $MSY B_{trigger}$ the advised F_{MSY} is reduced accordingly ($SSB_{2023}/MSY B_{trigger}$).

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.
	<p>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:</p> <ul style="list-style-type: none"> • 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%. <p>ICES considers that the F_{MSY} range for this stock used in the MAP is precautionary.</p>

Quality of the assessment

A revision in the estimation of survey indices for the recent 3 years has resulted in lower numbers of the younger fish in the survey series. The revised index led to a downscaling of recruitment since 2018 and thereby a lower estimated SSB in 2020 (16%) and 2021 (20%) compared to last year's assessment.

* Version 2: number updated

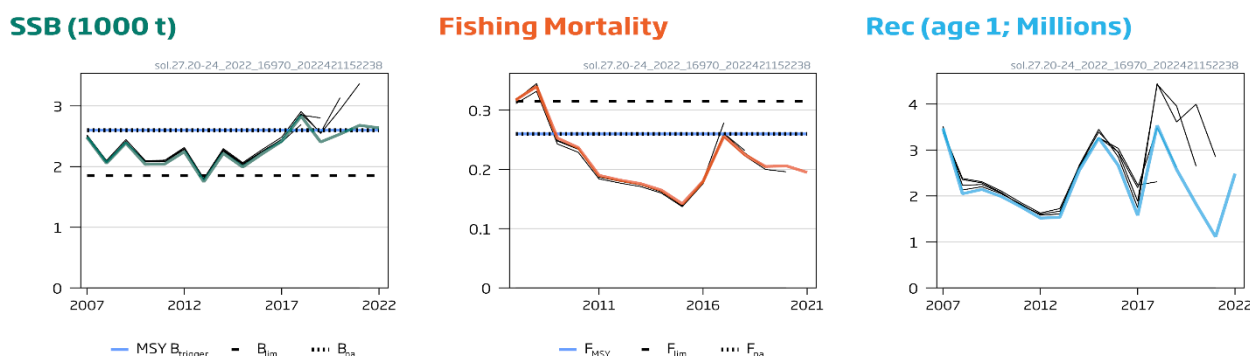


Figure 2 Sole in subdivisions 20–24. Historical assessment results (final-year assumed recruitment estimate included).

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 $B_{trigger}$	2 600	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, 2021)
Precautionary approach	B_{lim}	1 850	B_{loss} from 1992 (low productivity regime)	ICES (2015a)
	B_{pa}	2 600	$B_{lim} \times e^{1.645\sigma}$, $\sigma = 0.20$.	ICES (2015a)
	F_{lim}	0.315	Equilibrium scenarios $\text{prob}(SSB < B_{lim}) = 50\%$ with stochastic recruitment	ICES (2015a)
	F_{pa}	0.26	F_{P05} . The F that leads to $SSB \geq B_{lim}$ with 95% probability	ICES (2015a, 2021)
Management plan*	MAP B_{MGT}	2 600	MSY $B_{trigger}$	ICES (2015a)
	MAP B_{lim}	1 850	B_{lim}	ICES (2015a)
	MAP F_{MSY}	0.26	F_{MSY}	ICES (2015a, 2021)
	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, 2022a)
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included in the forecast (ICES, 2022b).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua sole survey, 2004–2021, [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 by weight in 2017–2021 is 2.3%.
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	1 050	-
1991	TAC	-	1 000	1 000	- [^]	-
1992	TAC	-	1 000	1 400	- [^]	-
1993	TAC at recent catch levels	-	1 000	1 600	- [^]	-
1994	No advice due to uncertain catches	-	-	2 100	1 198	-
1995	No advice	-	-	2 250	1 297	-
1996	No advice	-	-	2 250	1 059	-
1997	No advice	-	-	2 250	814	-
1998	No advice	-	-	1 800	605	-
1999	No increase in F	-	800	1 350	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	387	6
2022	Management plan	723 (range 544–723)		715		
2023	Management plan	504 (range –380 - 504)				

* 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 2021 as estimated by ICES.

Catch	Landings		Discards
393 tonnes	Active gears 54 %	Passive gears 46 %	6 tonnes
	387 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

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		
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	1 050
1991	746	216		38	+				1 000	1 011
1992	856	372		54					1 282	1 294
1993	1016	355		68	9				1 448	1 439
1994	890	296		12	4				1 202	1 198
1995	850	382		65	6				1 303	1 297
1996	784	203		57	612				1 656	1 059
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		434	434
2019	150	88	82	13	15		69	2	417	417
2020	136	109	85	9	24		60	1	424	424
2021	121	116	70	10	23		47		387	387

* 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 (Age 1)			Spawning stock biomass			Landings	Discards	Fishing Mortality (Ages 4-8)		
	R	Low	High	SSB	Low	High			F	Low	High
				tonnes							
1984	6 421	3 885	10 614	864	696	1 072	337		0.40	0.30	0.54
1985	5 218	3 351	8 126	1 121	895	1 403	397		0.32	0.24	0.42
1986	4 807	3 146	7 345	2 030	1 615	2 550	643		0.37	0.29	0.47
1987	4 333	2 796	6 714	2 099	1 739	2 534	722		0.45	0.36	0.57
1988	5 923	3 876	9 051	2 163	1 818	2 572	706		0.41	0.32	0.52
1989	7 663	5 000	11 743	2 179	1 851	2 565	824		0.42	0.33	0.53
1990	7 544	4 949	11 499	2 709	2 299	3 193	1 050		0.39	0.31	0.49
1991	8 547	5 529	13 213	3 195	2 693	3 791	1 011		0.46	0.38	0.57
1992	6 507	4 258	9 944	4 153	3 525	4 892	1 294		0.53	0.42	0.66
1993	3 544	2 331	5 387	3 961	3 340	4 697	1 439		0.53	0.43	0.67
1994	3 529	2 333	5 338	4 138	3 534	4 846	1 198		0.43	0.34	0.53
1995	2 291	1 501	3 497	3 428	2 964	3 965	1 297		0.46	0.37	0.56
1996	1 529	953	2 454	3 251	2 825	3 742	1 059		0.41	0.33	0.51
1997	3 638	2 364	5 599	2 635	2 288	3 034	814		0.40	0.32	0.49
1998	3 693	2 442	5 586	1 877	1 615	2 182	605		0.38	0.31	0.47
1999	3 096	2 029	4 723	2 252	1 915	2 650	637		0.35	0.28	0.43
2000	4 422	2 926	6 683	2 290	1 953	2 686	645		0.34	0.27	0.42
2001	5 968	3 896	9 142	2 240	1 920	2 612	478		0.29	0.23	0.36
2002	4 406	2 915	6 659	2 599	2 217	3 046	862		0.37	0.29	0.46
2003	4 493	2 986	6 761	2 968	2 535	3 476	618		0.34	0.27	0.43
2004	2 918	2 037	4 180	3 197	2 760	3 703	824		0.39	0.31	0.49
2005	2 485	1 717	3 597	3 483	2 991	4 056	990		0.40	0.32	0.50
2006	3 243	2 234	4 707	2 957	2 528	3 460	836		0.36	0.29	0.45
2007	3 472	2 411	5 001	2 483	2 132	2 893	633		0.32	0.25	0.40
2008	2 048	1 376	3 048	2 055	1 745	2 419	655		0.34	0.27	0.44
2009	2 142	1 489	3 083	2 388	1 991	2 864	641		0.25	0.195	0.33
2010	1 987	1 379	2 863	2 036	1 691	2 451	538	14	0.24	0.181	0.31
2011	1 764	1 200	2 595	2 044	1 680	2 486	552	8	0.190	0.145	0.25
2012	1 519	974	2 370	2 245	1 823	2 765	358	11	0.182	0.138	0.24

Year	Recruitment (Age 1)			Spawning stock biomass			Landings	Discards	Fishing Mortality (Ages 4-8)		
	R	Low	High	SSB	Low	High			F	Low	High
				tonnes							
2013	1 535	999	2 360	1 749	1 420	2 153	332	10	0.176	0.134	0.23
2014	2 555	1 762	3 706	2 217	1 817	2 706	335	32	0.165	0.126	0.22
2015	3 260	2 204	4 822	1 992	1 631	2 432	224	6	0.142	0.107	0.189
2016	2 666	1 847	3 847	2 210	1 822	2 682	348	17	0.180	0.139	0.23
2017	1 577	1 036	2 400	2 416	2 003	2 915	520	17	0.26	0.195	0.34
2018	3 534	2 313	5 400	2 832	2 333	3 439	434	7	0.23	0.174	0.29
2019	2 574	1 749	3 788	2 405	1 972	2 932	417	8	0.21	0.157	0.27
2020	1 822	1 192	2 784	2 536	2 049	3 140	424	12	0.21	0.155	0.27
2021	1 110	595	2 070	2 680	2 122	3 386	387	6	0.195	0.141	0.27
2022	2485*			2 637	3 614	1 937					

* Resampled from recruitment in 2004–2021.

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