

### 6.3.43 Sole (*Solea solea*) in Division IIIa and Subdivisions 22–24 (Skagerrak and Kattegat, (update) Western Baltic Sea)

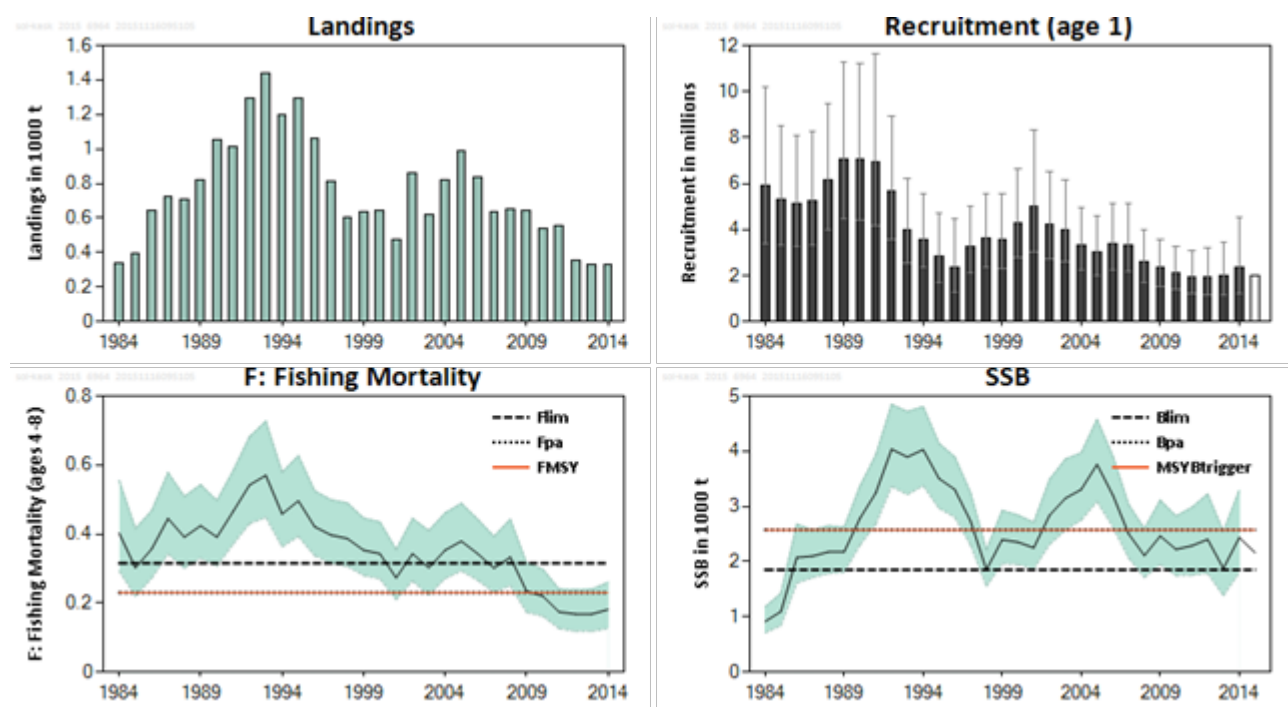
#### ICES stock advice

**Please note:** The present advice replaces the advice given for this stock in June 2015.

ICES advises that when the MSY approach is applied, catches in 2016 should be no more than 394 tonnes. If discard rates do not change from the average (2010–2014), this implies landings of no more than 379 tonnes.

#### Stock development over time

Spawning-stock biomass (SSB) has decreased since 2005 and has been close to  $B_{lim}$  since 2008. Fishing mortality has decreased since 2005 and is now below  $F_{MSY}$ . The last strong year class was the 2000 year class.



**Figure 6.3.43.1** Sole in Division IIIa and Subdivisions 22–24. Summary of stock assessment (weights in tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Predicted values are not shadowed.

#### Stock and exploitation status

**Table 6.3.43.1** Sole in Division IIIa and Subdivisions 22–24. State of the stock and fishery relative to reference points.

		Fishing pressure			Stock size				
		2012	2013	2014	2013	2014	2015		
Maximum sustainable yield	$F_{MSY}$	✓	✓	✓	MSY	✗	✗	✗	Below trigger
Precautionary approach	$F_{pa}$ , $F_{lim}$	✓	✓	✓	$B_{pa}$ , $B_{lim}$	○	○	○	Increased risk
Management plan	$F_{MGT}$	-	-	-	$SSB_{MGT}$	-	-	-	Not applicable

## Catch options

**Table 6.3.43.2** Sole in Division IIIa and Subdivisions 22–24. The basis for the catch options.

Variable	Value	Source	Notes
F ages 4–8 (2015)	0.13	ICES (2015a)	F corresponding to TAC constraint of landings of 205 t in 2015. F corresponds only to landings.
SSB (2016)	2461 t	ICES (2015a)	F (TAC constraint) = 0.13
R <sub>age1</sub> (2015–2016)	1.991 mill.	ICES (2015a)	Sampling from recent low recruitment (2010–2014).
Total catch (2015)	213 t	ICES (2015b)	Assumed landings (quota in 2015) plus discards.
Landings (2015)	205 t*	ICES (2015b)	Assessment not including discards, topping up in advice.
Discards (2015)	4%	ICES (2015b)	Mean (2010–2014). Discard rate in weight.

\* TAC constraint of 205 t in 2015.

**Table 6.3.43.3** Sole in Division IIIa and Subdivisions 22–24. The catch options. Weights in tonnes.

Rationale	Total catch (2016)*	Wanted catch (2016)**	Basis	F wanted catch (2016)	SSB (2017)	%SSB change***	%TAC change wanted catch^
MSY approach	394	379	$F_{MSY} \times (SSB_{2016}/MSY B_{trigger})$	0.22	2599	6%	85%
Precautionary approach	394	379	$SSB_{2017} = B_{pa}$	0.22	2599	6%	85%
Zero catch	0	0	$F = 0$	0.00	3000	22%	-100%
Other options	123	119	$F_{2015} \times 0.5$	0.07	2875	17%	-42%
	238	229	$F_{sq} (F_{2015})$	0.13	2755	12%	12%
	406	390	$F_{MSY}$	0.23	2588	5%	90%
	181	174	-15% TAC ( $F_{2015} \times 0.7$ )	0.09	2816	14%	-15%
	213	205	No change TAC ( $F_{2015} \times 0.9$ )	0.11	2784	13%	0%
	245	236	+15% TAC ( $F_{2015} \times 1.0$ )	0.13	2749	12%	15%

\* 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).

\*\* The “wanted catch” is used to describe fish that would be landed in the absence of the EU landing obligation.

\*\*\* SSB 2017 relative to SSB 2016.

^ Wanted catch 2016 relative to TAC 2015.

## Basis of the advice

**Table 6.3.43.4** Sole in Division IIIa and Subdivisions 22–24. The basis of the advice.

Advice basis	The MSY approach.
Management plan	There is no management plan for sole in this area.

## Quality of the assessment

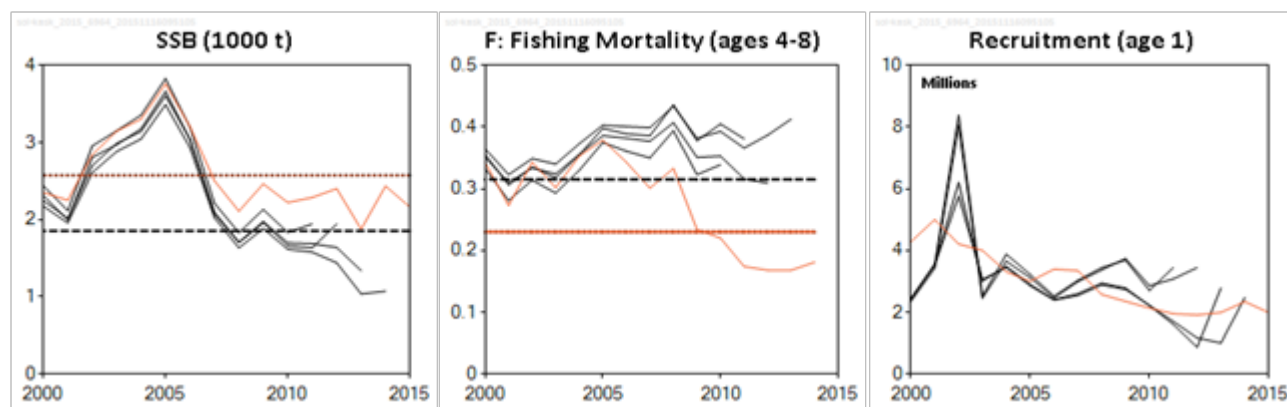
This stock has gone through an inter-benchmark process in the autumn of 2015 (ICES, 2015a). The commercial trawl landings per unit effort (lpue), used previously as an abundance index in this assessment, has now been excluded from the assessment. This is because several gear changes, such as the introduction of SELTRA trawls, have likely reduced the efficiency of the fleet for catching sole, so that these data are no longer considered to provide a reliable abundance index. ICES (2015c) advised that there was no quantitative information to quantify the likely reduction in catchability. The exclusion of this lpue series from the assessment changes the perception of both fishing mortality and SSB significantly in recent years (see Figure 6.3.43.2) and has also resulted in a more consistent assessment with no bias.

The cooperative Fishermen–DTU Aqua sole survey, discontinued in 2011, was resumed in 2014. The survey is expected to continue annually and is the only source for fisheries-independent information. A recruitment index of age 1 is now obtained

from the survey and used in the assessment (ICES, 2015a). This has improved the quality of the assumptions on recruitment and younger age groups used in the catch forecast.

Sufficient biological sampling of landings is difficult to obtain due to the low total landings which are dispersed spatially. This affects the quality of the input data, including the weight-at-age.

Discard rates in recent years are low and vary around 4% in weight. They are not included in the assessment. Discarding in 2014 increased to 9% in weight, which will increase the uncertainty of the assessment.



**Figure 6.3.43.2** Sole in Division IIIa and Subdivisions 22–24. Historical assessment results (final-year recruitment estimates included). Recruitment age in the assessment has changed from 2 to 1 following the inter-benchmark in 2015 (ICES, 2015a).

### Issues relevant for the advice

After the inter-benchmark in late 2015, new reference points were defined (ICES, 2015a) and adopted for the stock. The changes in reference points in combination with a revised assessment and a new perception of the stock has changed the stock status and the catch advice for the stock.

In September 2015 ICES received the following request from the European Commission:

*“We understand that ICES has performed an inter-benchmark for sole in the Skagerrak/Kattegat and Western Baltic Sea or will do so in the autumn. This will mean a new stock assessment can be made for 2016. Given that fishing opportunities for 2016 will be negotiated in December of 2015, we would need to know by the end of October whether the inter-benchmark would result in updated advice for 2016.*

**Request:**

*If justified by the results of the inter-benchmark exercise, ICES is requested to update its catch advice for 2016.”*

Given the change in stock perception arising from the inter-benchmark, ICES has updated its catch advice for 2016, in line with the request.

## Reference points

**Table 6.3.43.5** Sole in Division IIIa and Subdivisions 22–24. 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	$SSB_{MGT}$	Not defined.		
	$F_{MGT}$	Not defined.		

## Basis of the assessment

**Table 6.3.43.6** Sole in Division IIIa and Subdivisions 22–24. The basis of the assessment.

ICES stock data category	1 (ICES, 2015d).
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included afterwards in the forecast (ICES, 2015a).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua 2004–2011 and 2014), 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 2010–2014 from main fleets are 4%.
Indicators	None.
Other information	Stock inter-benchmarked in 2015 (ICES, 2015a).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS).

**Information from stakeholders**

There is no available information.

**History of advice, catch, and management**

**Table 6.3.43.7** Sole in Division IIIa and Subdivisions 22–24. History of ICES advice, the agreed TAC, and ICES estimates of landings. Weights in thousand tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Predicted landings corresp. to advice	Agreed TAC*	ICES landings**	ICES discards***
1987	-	-	-	0.85	0.72	-
1988	-	-	-	0.95	0.71	-
1989	TAC	-	< 0.8	0.80	0.82	-
1990	Precautionary TAC	-	0.6	0.50	1.05	-
1991	TAC	-	1.0	1.00	-^	-
1992	TAC	-	1.0	1.40	-^	-
1993	TAC at recent catch levels	-	1.0	1.60	-^	-
1994	No advice due to uncertain catches	-	-	2.10	1.20	-
1995	No advice	-	-	2.25	1.30	-
1996	No advice	-	-	2.25	1.10	-
1997	No advice	-	-	2.25	0.81	-
1998	No advice	-	-	1.80	0.61	-
1999	No increase in F	-	0.8	1.35	0.64	-
2000	No increase in F	-	0.65	0.95	0.65	0.169
2001	No increase in F	-	0.7	0.70	0.48	-
2002	F below F <sub>pa</sub>	-	0.5	0.50	0.86	0.010
2003	F below F <sub>pa</sub>	-	0.3	0.35	0.62	0.043
2004	F below F <sub>pa</sub>	-	0.5	0.52	0.82	-
2005	No increase in F	-	0.85	0.90	0.99	-
2006	F below F <sub>pa</sub>	-	0.82	0.90	0.84	-
2007	Limit catches to 2002–2005 average	-	0.74	0.90	0.63	-
2008	F below F <sub>pa</sub>	-	0.97	0.94	0.66	-
2009	F below F <sub>pa</sub>	-	0.80	0.80	0.64	-
2010	F below F <sub>pa</sub>	-	0.62	0.70	0.54	0.014
2011	See scenarios	-	-	0.84	0.55	0.008
2012	MSY framework	-	0.61	0.61^^	0.36	0.011
2013	MSY framework	-	0.56	0.59	0.33	0.010
2014	MSY approach	0.353	0.353^^^	0.35	0.33	0.032
2015	MSY approach	0.211	0.205	0.205		
2016	MSY approach	≤ 0.394				

\*TAC applies to Division IIIa and the EC waters of Divisions IIIb and IIIc, d.

\*\*Landings include Division IIIa and Subdivisions 22–24.

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

^ Uncertain.

^^ No more than 461 t in Division IIIa.

^^^ Discarding assumed to be negligible.

## History of catch and landings

**Table 6.3.43.8** Sole in Division IIIa and Subdivisions 22–24. Catch distribution by fleet in 2014 as estimated by ICES.

Total catch (2014)	Official landings		Discards
365 t	44% demersal trawl	56% gillnets	32 t
	333 t		

**Table 6.3.43.9** Sole in Division IIIa and Subdivisions 22–24. History of official commercial landings by country and area and ICES estimates.

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

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak+Kattegat	Kattegat+Belts	Skagerrak	Skagerrak	Skagerrak		
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	137	101	45	38	1	12	0.02	0.01	333	333

\*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 6.3.43.10** Sole in Division IIIa and Subdivisions 22–24. Assessment summary with weights in tonnes. Recruitment in thousands.

Year	Recruitment (Age 1)	High	Low	SSB	High	Low	Landings	Mean F (Ages 4–8)	High	Low
1984	5892	10206	3402	916	1181	710	337	0.403	0.555	0.293
1985	5304	8512	3305	1096	1428	842	397	0.302	0.416	0.220
1986	5140	8084	3269	2075	2678	1609	643	0.357	0.468	0.272
1987	5240	8279	3317	2099	2575	1711	722	0.445	0.578	0.342
1988	6152	9463	3999	2175	2651	1785	706	0.391	0.509	0.301
1989	7078	11272	4445	2177	2624	1807	824	0.424	0.543	0.330
1990	7028	11209	4406	2783	3369	2299	1050	0.391	0.497	0.307
1991	6957	11624	4164	3244	3931	2677	1011	0.466	0.584	0.371
1992	5643	8912	3573	4036	4847	3360	1294	0.542	0.682	0.430
1993	3978	6185	2559	3894	4719	3213	1439	0.57	0.727	0.448
1994	3591	5523	2335	4027	4808	3374	1198	0.458	0.579	0.363
1995	2849	4717	1721	3504	4142	2965	1297	0.496	0.627	0.393
1996	2356	4460	1245	3306	3897	2804	1059	0.421	0.525	0.337
1997	3280	5025	2142	2732	3247	2298	814	0.397	0.499	0.315
1998	3617	5556	2354	1853	2212	1552	605	0.387	0.49	0.306
1999	3577	5539	2310	2396	2927	1961	638	0.353	0.446	0.280
2000	4283	6644	2761	2352	2841	1947	646	0.343	0.435	0.270
2001	5002	8337	3001	2251	2711	1869	476	0.273	0.355	0.210
2002	4210	6505	2724	2840	3491	2311	862	0.343	0.445	0.264
2003	4003	6174	2595	3148	3857	2570	619	0.302	0.41	0.223

Year	Recruitment (Age 1)	High	Low	SSB	High	Low	Landings	Mean F (Ages 4–8)	High	Low
2004	3307	4955	2208	3304	3969	2751	824	0.353	0.461	0.271
2005	3002	4578	1969	3760	4579	3088	990	0.379	0.489	0.293
2006	3395	5127	2248	3207	3914	2628	836	0.343	0.443	0.266
2007	3348	5147	2177	2504	3035	2065	633	0.301	0.393	0.231
2008	2572	3955	1672	2109	2599	1712	655	0.333	0.443	0.250
2009	2351	3589	1540	2464	3113	1950	641	0.234	0.316	0.173
2010	2135	3279	1390	2222	2826	1747	538	0.22	0.298	0.162
2011	1951	3102	1227	2287	2982	1755	552	0.174	0.24	0.126
2012	1910	3209	1137	2402	3226	1789	358	0.168	0.239	0.118
2013	1991	3470	1143	1876	2546	1382	332	0.168	0.24	0.118
2014	2340	4530	1209	2435	3294	1800	333	0.181	0.26	0.126
2015	1991			2162						
<b>Average</b>	<b>3921</b>	<b>6360</b>	<b>2502</b>	<b>2614</b>	<b>3233</b>	<b>2140</b>	<b>753</b>	<b>0.352</b>	<b>0.458</b>	<b>0.271</b>

### Sources and references

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