

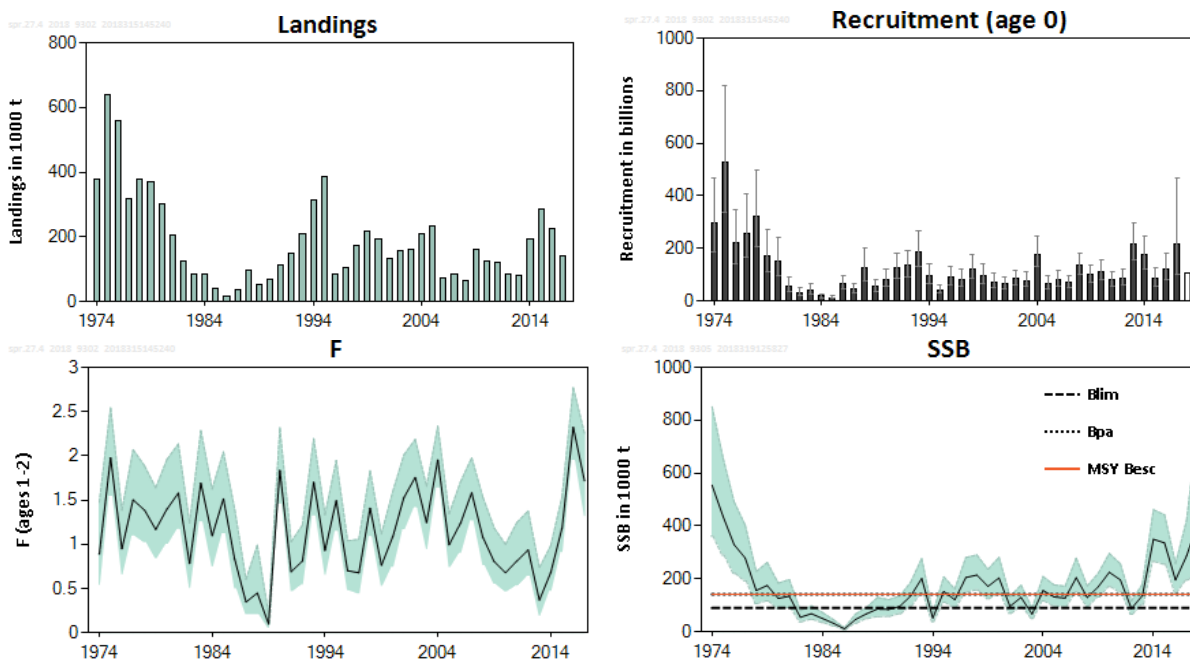
## Sprat (*Sprattus sprattus*) in Subarea 4 (North Sea)

### ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in the period from 1 July 2018 to 30 June 2019 should be no more than 177 545 tonnes.

### Stock development over time

The spawning-stock biomass (SSB) has been at or above  $MSY_{B_{escapement}}$  since 2013. Fishing mortality (F) has been higher than average for the last three years. Recruitment (R) in 2017 is estimated to be above average, but with substantial uncertainty.



**Figure 1** Sprat in Subarea 4. Summary of the stock assessment. Historical development from the summary of the stock assessment with 90% confidence intervals. Years on the x-axes refer to the model years (i.e. 2009 corresponds to 07/2009 to 06/2010), recruitment and SSB are for July 1 of the given year; predicted values for recruitment and SSB are shown as an unshaded bar and a diamond shape.

### Stock and exploitation status

ICES assesses that the size of the spawning stock is above  $MSY_{B_{escapement}}$ ,  $B_{pa}$ , and  $B_{lim}$ .

**Table 1** Sprat in Subarea 4. State of the stock and fishery relative to reference points.

		Fishing pressure			Stock size					
		2015	2016	2017	2016	2017	2018			
Maximum sustainable yield	$F_{MSY}$	?	?	?	Undefined	$MSY_{B_{escapement}}$	✓	✓	✓	Above trigger
Precautionary approach	$F_{pa}, F_{lim}$	?	?	?	Undefined	$B_{pa}, B_{lim}$	✓	✓	✓	Full reproductive capacity
Management plan	$F_{MGT}$	—	—	—	Not applicable	$SSB_{MGT}$	—	—	—	Not applicable

## Catch scenarios

**Table 2** Sprat in Subarea 4. Assumptions made for the interim year and in the forecast.

Variable	Value	Notes
$F_{\text{ages 1-2}}$ (2017)	1.718	Based on observed catch for quarter 3 and 4 in 2017 plus estimated catch for quarter 1 of 2018. Catch in quarter 2 of 2018 is assumed to be zero.
SSB (2018)	408808	In tonnes
$R_{\text{age0}}$ (2017)	217563213	Model output in thousands
$R_{\text{age0}}$ (2018)	103850979	Geometric mean (GM 1998–2017) in thousands
Discards (2017)	-	Discarding is assumed to be negligible.
Total catch (2017)	139623	Model-estimated catch in tonnes

Note: Years refer to the period July to the following June (e.g. 2016 corresponds to July 2016 to June 2017). Recruitment and SSB are for 1 July of the given year.

**Table 3** Sprat in Subarea 4. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch* (July 2018–June 2019)	$F_{\text{total}}$ (July 2018–June 2019)	SSB (2019)	% SSB change *	% TAC change **	% Advice change***
ICES advice basis						
$SSB_{2019} \geq$ MSY $B_{\text{escapement}}$ with $F_{\text{cap}}$	177545	0.70	496976	22%	+1%	+5%
Other scenarios						
$F = 0$	0	0	643494	+57%	-100%	-100%
$F = 0.4$	108652	0.40	553079	+35%	-38%	-36%
$F = 0.8$	198456	0.80	480170	+17%	+12%	+16%
$F = 1.0$	237530	1.00	449079	+10%	+35%	+40%
$SSB_{2019} =$ MSY $B_{\text{escapement}} =$ $B_{\text{pa}}$	730442	9.60	142000	-65%	+314%	+329%
$F = F_{2017}$	352615	1.70	360354	-11%	100%	+107%

\* SSB in July 2019 relative to SSB in July 2018.

\*\* Relative to the TAC set for 1 July to 30 June.

\*\*\* Advice value 2018 relative to advice value 2017.

There is no major change in advised catches this year compared to those advised last year.

## Basis of the advice

**Table 4** Sprat in Subarea 4. The basis of the advice.

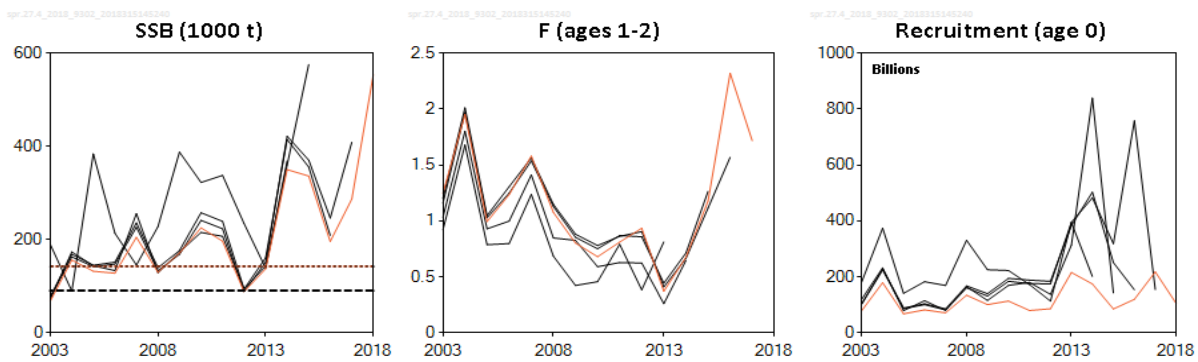
Advice basis	MSY approach (escapement strategy with $F_{\text{cap}} = 0.7$ ).
Management plan	There is no management plan for sprat in this area.

## Quality of the assessment

The change in recruitment level between this year's assessment and previous years is caused by a recent update of natural mortality of sprat in the first six months of their life (ICES, 2017).

Consequently, the 2018 assessment also revised the 2017 SSB downwards. The assessment has a tendency to overestimate above-average recruitments. The 2017 recruitment is estimated to be high, but this estimate is highly uncertain as it is based solely on the IBTSQ1 survey.

The realized  $F$  in the period July 2016 to June 2017 and again from July 2017 to June 2018 is estimated to be more than double the  $F_{\text{cap}}$ . This high realized  $F$  in 2017 was caused by the downwards revision of the 2015 year class. The SSB is still estimated to be high by 1 July 2018, owing to the contribution of the large incoming 2017 year class. Despite these uncertainties, SSB in 2018 and 2019 is estimated to be well above MSY  $B_{\text{escapement}}$ .



**Figure 2** Sprat in Subarea 4. Historical assessment results (final-year recruitment and SSB estimates included).

### Issues relevant for the advice

There is no management plan for sprat in this area; however, the within-year TAC setting rule (MSY  $B_{\text{escapement}}$  with an  $F_{\text{cap}}$ ) has been evaluated by ICES to be precautionary and consistent with the ICES MSY approach (ICES, 2014a).

The advice is based on the MSY escapement strategy (with an  $F_{\text{cap}}$ ), which relies on a prediction of SSB after the fishery has taken place. A high proportion of the predicted SSB consists of recruits for which the abundance and proportion of mature fish is unknown. This contributes to the uncertainty in the advice.

The stock will be benchmarked in 2018.

### Reference points

**Table 5** Sprat in Subarea 4. Reference points, values, and their technical basis. All weights are in tonnes.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{escapement}}$	142000	Equal to $B_{\text{pa}}$ , used in conjunction with $F_{\text{cap}}$ .	ICES (2013)
	$F_{\text{cap}}$	0.70	MSY criteria based on the MSY $B_{\text{escapement}}$ strategy with an additional constraint on fishing mortality; $F_{\text{cap}} = 0.7$ .	ICES (2013), ICES (2014a)
	MSY $B_{\text{trigger}}$	Not defined		
	$F_{\text{MSY}}$	Not defined		
Precautionary approach	$B_{\text{lim}}$	90000	$B_{\text{lim}}$ was set such that that years of very good recruitment mainly occurred when the stock was above $B_{\text{lim}}$ , and years of very low recruitment only occurred when the stock was below $B_{\text{lim}}$ (ICES, 2013).	ICES (2013)
	$B_{\text{pa}}$	142000	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$ , with $\sigma = 0.28$ estimated from assessment uncertainty in the terminal year.	ICES (2013)
	$F_{\text{lim}}$	Not defined		
	$F_{\text{pa}}$	Not defined		
Management plan	SSB <sub>mgt</sub>	Not applicable		
	$F_{\text{mgt}}$	Not applicable		

## Basis of the assessment

**Table 6** Sprat in Subarea 4. Basis of assessment and advice.

ICES stock data category	1 ( <a href="#">ICES, 2016</a> )
Assessment type	Age-based analytical assessment (SMS; ICES, 2018) that uses landings in the model and in the forecast.
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), three survey indices (IBTS Q1&Q3, HERAS), annual maturity data from IBTS Q1 survey (ICES, 2014b), and natural mortalities from the multispecies model (ICES, 2017).
Discards and bycatch	Discards are not included. Discarding is known to have taken place prior to 2015, but the amount has not been quantified. Discarding has been assumed negligible since 2016.
Indicators	None
Other information	To match the sprat life cycle, the assessment and advice year is July to June. Latest benchmark was in 2013 (WKSPRAT; ICES, 2013).
Working group	Herring Assessment Working Group for the Area South of 62°N ( <a href="#">HAWG</a> )

## Information from stakeholders

No additional information is available.

## History of the advice, catch, and management

**Table 7** Sprat in Subarea 4. ICES advice and official and ICES landings. All weights are in tonnes. Values of landings for the period 1987 to 2014 are presented to the nearest thousand tonnes.

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC*	Official landings	ICES landings
1987	Catch at lowest practical level	0	57000	78000	32000
1988	TAC < recent catches, preferably zero	0	57000	93000	87000
1989	No advice	-	59000	50000	63000
1990	No advice	-	59000	49000	73000
1991	No advice	-	55000	92000	112000
1992	No advice	-	55000	72000	124000
1993	No advice	-	114000	127000	200000
1994	No advice for sprat; maintain bycatch regulations	-	114000	184000	320000
1995	No advice	-	175000	190000	357000
1996	No advice	-	200000	141000	136000
1997	Enforce bycatch regulations	-	150000	123000	103000
1998	Limited by restrictions on juvenile herring	-	150000	175000	163000
1999	Limited by restrictions on juvenile herring	-	225000	167000	188000
2000	Limited by restrictions on juvenile herring	-	225000	208000	196000
2001	Catch prediction	225000	225000	180000	170000
2002	Catch prediction	160000	232000	167000	144000
2003	Catch prediction	175000	257000	201000	177000
2004	Catch prediction	171000	257000	208000	194000
2005	Catch prediction	244000	257000	242000	206000
2006	Catch predictions	< 250000	175000	135000	114000
2007	Catch prediction	< 195000	175000	99000	84000
2008	Catch prediction	< 170000	170000	75000	61000
2009	No advice	-	170000	140000	133000
2010	No advice	-	170000	155000	143000
2011	Reduce catches	-	170000	143000	134000

Year	ICES advice	Predicted catch corresponding to advice	Agreed TAC*	Official landings	ICES landings
2012	Reduce catches		162000	95000	86000
In year	No increase in catches (2011)	< 134000			
2013**	MSY approach, $F_{cap}$ (catches)	< 144000	162000	70600	66000
2014**	MSY approach, $F_{cap}$ (wanted catch##)	< 227000	144000	157000	140000
2015**	MSY approach, $F_{cap}$ (wanted catch##)	≤ 506000	***350000	299000	290380
2016**	MSY approach, $F_{cap}$ (catch)	≤ 125541	***245000	255513	240673
2017**	MSY approach, $F_{cap}$ (catch)	≤ 170387	#176411	128316	128660
2018**	MSY approach, $F_{cap}$ (catch)	≤ 177545			

\* TACs are set for January–December whereas the advice since 2013 has been given for July (of the TAC year) to June of the next year.

\*\* Advice for 1 July to 30 June.

\*\*\* Final TAC following an in-year revision

# TAC for 1 July to 30 June.

## The term “wanted catch” is used to describe fish that would be landed in the absence of the EU landing obligation (EU, 2013).

### History of the catch and landings

**Table 8** Sprat in Subarea 4. Catch distribution by fleet in 2017 as estimated by ICES (in tonnes).

Catch (2017)	Landings		Discards
	Industrial trawl 99%	Purse-seine 1%	
128660	128660		negligible

**Table 9** Sprat in Subarea 4. History of commercial catch and landings; ICES estimated values are presented by area for each country participating in the fishery. All weights are in tonnes. See ICES (2006) for earlier landings data. Catches in fjords of western Norway are excluded. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes. The Division 4.b catches for 2000–2007 divided by divisions 4.b West and 4.b East can be found in ICES (2008).

Year	Quarter	Area				Total
		Division 4.a West	Division 4.a East	Division 4.b	Division 4.c	
2008	1			2872	43	2915
	2			52	*	52
	3			21787		21787
	4			27994	8334	36329
	Total			52706	8377	61083
2009	1			36	1268	1304
	2			2526	1	2527
	3		22	41513		41535
	4			78373	9336	87709
	Total		22	122448	10604	133075
2010	1			10976	17072	28048
	2			3235	3	3238
	3			14220		14220
	4			62006	35973	97979
	Total			90437	53048	143485
2011	1			3747	21039	24786
	2			2067	3	2070
	3			22309	451	22761
	4	8		70256	13759	84023
	Total	8		98380	35252	133640
2012	1			81	1649	1730
	2			2924	0	2924
	3			26779	307	27086
	4			47765	6060	53825
	Total	0	0	77549	8016	85565

Year	Quarter	Area				Total
		Division 4.a West	Division 4.a East	Division 4.b	Division 4.c	
2013	1			1281	3158	4438
	2			32	0	32
	3			25577	720	26297
	4			18892	16276	35167
	Total	0	0	45781	20154	65934
2014	1			59	125	184
	2			11631	3	11635
	3	1		88457	1428	89885
	4	7		37851	822	38681
	Total	8		137999	2378	140384
2015	1		*	14816	16972	31788
	2			16843	107	16949
	3			124512	335	124847
	4	25		88395	28375	116795
	Total	25	*	244566	45789	290380
2016	1	68		18487	5969	24503
	2			8927	51	8978
	3	*		158522	111	158633
	4	2		34070	14466	48537
	Total	70		220007	20575	240673
2017	1	1		3432	1220	4654
	2			1327	*	1327
	3	*		92885	217	93102
	4	94		29310	174	29578
	Total	95		126954	1611	128660

\* < 0.5 tonnes.

**Summary of the assessment**

**Table 10** Sprat in Subarea 4. Assessment summary. Weights are in tonnes. High and Low refers to 90% confidence intervals.

Year*	Recruitment Age 0	High	Low	SSB	High	Low	Landings	F Ages 1–2	High	Low
	thousands			tonnes			tonnes	per year		
1974	295151694	468031349	186129674	554599	850912	361471	379747	0.887	1.473	0.534
1975	526099018	819480427	337750809	435827	656388	289379	637282	1.978	2.543	1.54
1976	223070852	347839013	143056423	329720	491456	221211	557359	0.949	1.384	0.651
1977	257878732	404770318	164294261	279009	403358	192995	318769	1.502	2.07	1.09
1978	319734013	498658114	205009879	156217	227847	107106	378632	1.387	1.889	1.018
1979	171483910	270905002	108549975	175255	262351	117074	368667	1.168	1.638	0.834
1980	152702173	239368400	97414503	126374	184075	86760	300239	1.398	1.96	0.997
1981	57368160	93186393	35317450	134861	197662	92013	203897	1.578	2.134	1.167
1982	32834817	50313317	21428227	55160	80031	38019	123379	0.783	1.237	0.496
1983	41574602	63609091	27172963	68528	98354	47747	85168	1.691	2.285	1.251
1984	18457844	28163005	12097147	50767	73093	35260	85617	1.097	1.624	0.741
1985	12397433	18419796	8344085	32306	45980	22698	40921	1.513	2.044	1.12
1986	64231224	94620288	43602172	11213	15344	8194	15687	0.83	1.393	0.494
1987	44145431	67266365	28971673	46911	67268	32714	37551	0.348	0.602	0.202
1988	124897006	202111233	77181569	68050	92385	50125	95972	0.447	0.989	0.202
1989	53704105	82424433	34991213	86509	130152	57500	51943	0.101	0.211	0.048
1990	82887929	120297538	57111799	84457	121591	58664	67386	1.835	2.316	1.453
1991	125648640	182279360	86612005	96086	134961	68409	114872	0.69	1.028	0.462
1992	133685422	193871390	92183751	135808	187436	98401	148236	0.809	1.216	0.538
1993	185580628	267237540	128874744	201592	277035	146694	209193	1.7	2.194	1.318
1994	95534691	138823301	65744563	52365	70128	39102	313687	0.93	1.333	0.649
1995	42712407	61286023	29767794	152665	208209	111938	387626	1.492	1.948	1.143
1996	91239639	132529745	62813610	121176	161815	90743	84573	0.701	1.039	0.473
1997	83053871	120429365	57277936	205253	280978	149937	104797	0.678	1.055	0.435
1998	122423879	177837979	84276746	214701	290570	158641	172063	1.408	1.831	1.083
1999	94678737	140592641	63759121	171785	236085	124998	215412	0.764	1.116	0.523
2000	72710765	106881095	49464831	203618	281782	147136	195170	1.083	1.593	0.737
2001	64359815	91806136	45118833	96375	133395	69629	131538	1.53	2.012	1.163
2002	85926256	118511010	62300722	129962	176784	95542	157248	1.755	2.185	1.41

Year*	Recruitment Age 0	High	Low	SSB	High	Low	Landings	F Ages 1–2	High	Low
	thousands			tonnes			tonnes	per year		
2003	78373781	111619965	55030025	67238	89323	50614	159515	1.246	1.655	0.939
2004	178660873	246716431	129378118	156061	208663	116719	207779	1.953	2.335	1.634
2005	67322159	94289537	48067615	131795	177258	97991	232048	0.994	1.344	0.734
2006	81327925	115842503	57096759	127516	172347	94347	74648	1.235	1.702	0.896
2007	70703102	97669084	51182302	204843	278490	150672	85080	1.581	1.978	1.263
2008	133819174	180316309	99311989	129573	173361	96845	63623	1.076	1.529	0.757
2009	100332477	138523810	72670583	170758	221670	131538	162714	0.802	1.183	0.544
2010	113011484	155266051	82256201	225032	296212	170957	126077	0.679	0.999	0.461
2011	79161450	108822254	57585052	196418	257265	149962	119083	0.81	1.245	0.527
2012	85326873	119106067	61127660	88080	116531	66575	86196	0.935	1.377	0.636
2013	215398423	295069816	157238992	137036	180385	104105	81268	0.37	0.736	0.186
2014	174249720	246255203	123298775	350109	461345	265694	192679	0.676	0.982	0.466
2015	84477856	124409160	57363205	336381	442577	255667	286086	1.178	1.532	0.905
2016	119162659	180908607	78491231	195830	258065	148603	225537	2.322	2.769	1.947
2017	217563213	466325520	101503670	286932	420383	195845	139623	1.718	2.252	1.311
2018	103850979**			408808***	770634***	216865***				

\* Years refer to the period July to the following June (e.g. 2016 corresponds to July 2016 to June 2017). Recruitment and SSB are for 1 July of the given year.

\*\* Geometric mean (1998–2017).

\*\*\* Average mean weight (2015–2017) and maturity (2008–2017).



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