ECOREGION North Sea
STOCK Sprat in Subarea IV (North Sea)

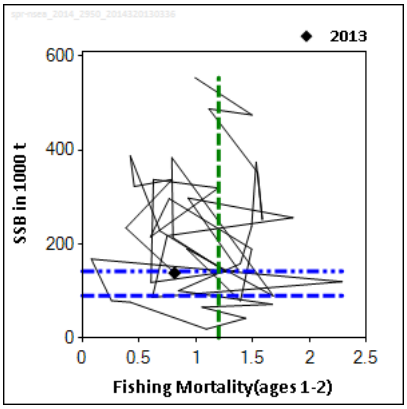
Advice for July 2014–June 2015

ICES advises on the basis of the MSY approach that the wanted catch[1] of sprat from July 2014 to June 2015 should be no more than 227 000 tonnes. The resulting total catch cannot be quantified as unwanted catch data are not fully available.

Stock status

Fishing pressure	2011	2012	2013	
MSY (F_{cap})	✓	✓	✓	Appropriate
Precautionary approach (F_{pa},F_{lim})	?	?	?	Undefined

Stock size	2012	2013	2014	
MSY ($B_{escapement}$)	✓	✗	✓	Above trigger
Precautionary approach (B_{pa},B_{lim})	✓	o	✓	Full reproductive capacity



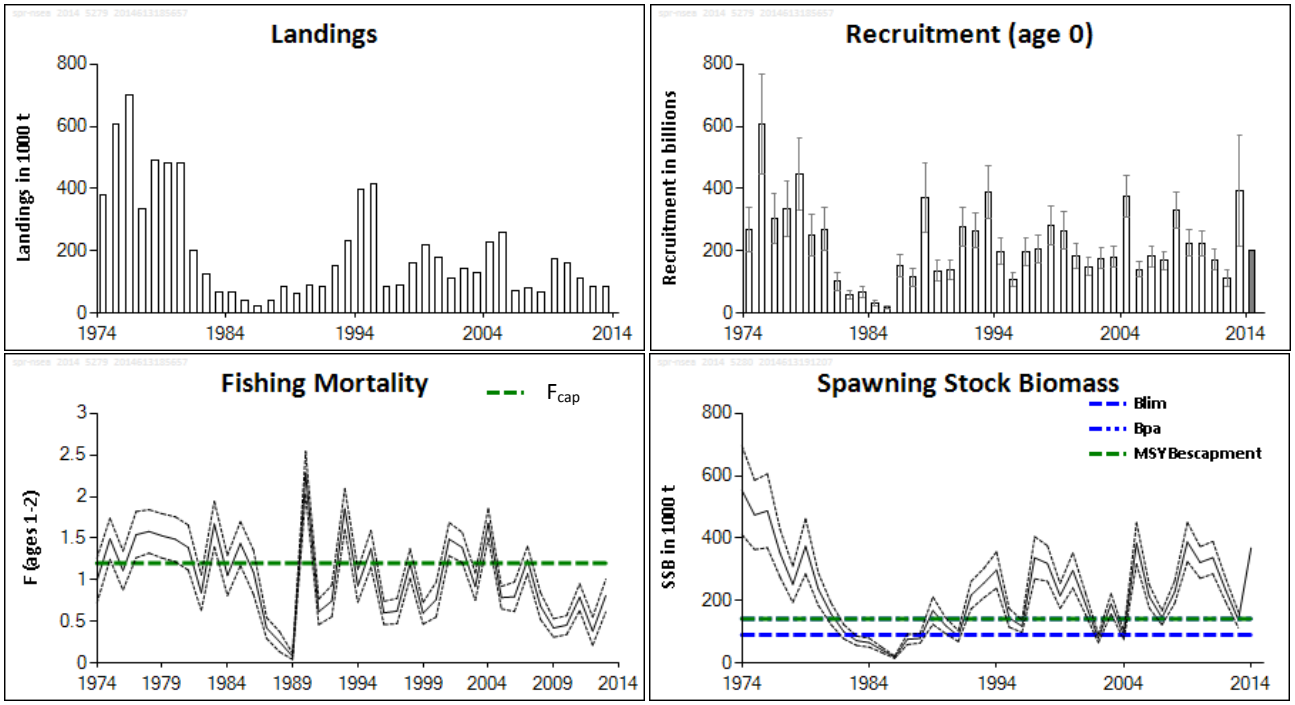


Figure 6.3.30.1 Sprat in the North Sea. Summary of stock assessment (weights in thousand tonnes). Top right: SSB and F over the years. NB: Years on the x-axes refer to the model years (i.e. 2009 corresponds to the period from July 2009 to June 2010). Predicted values are shaded.

The spawning stock has been at or above B_{pa} since 2005. Fishing mortality has shown an overall decreasing trend since 2004. SSB in 2013 is estimated to be at B_{pa}. Recruitment in 2013 is estimated to be one of the highest in the time-series.

Management plans

No specific management objectives are known to ICES.

[1] "Wanted catch" is used to describe fish that would be landed in the absence of the EU landing obligation. The "unwanted catch" refers to the component that was previously discarded.

Biology

Sprat in the North Sea is short-lived with high natural mortality. The age zero year class is largely unavailable to the fishery and the catch is dominated by fish of ages 1 and 2. Additionally, approximately half of the age zero year class that survives through the first year is expected to mature and contribute to the SSB. North Sea sprat spawns for a prolonged period during summer (i.e. batch spawner).

Environmental influence on the stock

The zooplankton community structure that sustains sprat stocks appears to be changing. The implications of the environmental change for sprat are unknown, but no trends in recruitment have been observed in the last years.

The fisheries

Sprat in Subarea IV is mainly fished together with juvenile herring and the exploitation of sprat is limited by the herring bycatch restrictions imposed on the fisheries. Discarding and slippage of sprat is understood to occur when the bycatch percentage of herring in the catch is higher than the allowed percentage. Two regulations limit the sprat trawl fishery in addition to the sprat TAC, one being the bycatch ceiling for herring and the other the herring bycatch percentage limit in industrial fisheries. Given the relatively large North Sea autumn-spawning herring stock, the sprat fishery has been limited by the bycatch limits. The majority of sprat landings are taken in the Danish small-meshed trawl fishery, which has about 10% bycatch of herring. The Norwegian sprat fishery is carried out by purse-seiners and small-meshed trawlers. Norwegian regulations for the North Sea sprat fishery allow for a maximum 10% (by weight) bycatch of herring. The bycatch percentage in this fishery is unknown.

Catch distribution	Total catch (2013) is unknown. Official landings were 70.6 kt (all gear types) of which all were industrial catch. Discards are known to take place but cannot be quantified.

Effects of the fisheries on the ecosystem

Sprat is an important prey species in the North Sea ecosystem. The effects of the sprat fishery on other fish species, marine mammals, and seabirds are at present unknown. Sprat that are found inshore are a food resource for breeding seabirds.

Quality considerations

The bycatch percentage of herring in landings monitored by the control agencies often reach more than the 20% limit. Until 2015, catches with a bycatch higher than this limit are not allowed to be landed. Therefore, discarding occurs but is not quantified.

The advice is set at the basis of the escapement strategy; however, after the catch has been taken the SSB consists of recruits for which abundance and proportion mature is unknown. This contributes to the uncertainity in the advice.

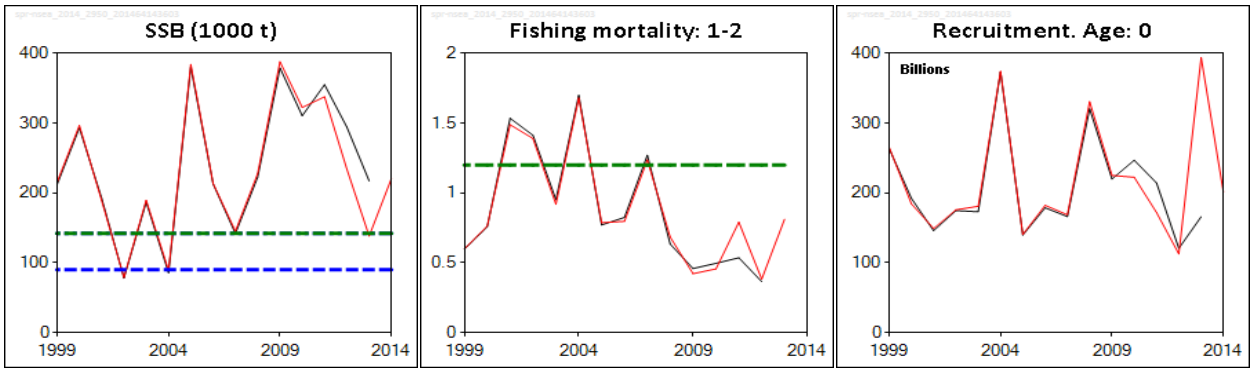


Figure 6.3.30.2 Sprat in the North Sea. Historical assessment results (final-year recruitment estimates included).

Scientific basis

Stock data category	1 (ICES, 2014b).
Assessment type	Age-based analytical assessment (SMS).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), three survey indices (IBTS Q1&3, HERAS), annual maturity data from HERAS survey, natural mortalities from multispecies model (WGSAM).
Discards and bycatch	Discards are known to take place but cannot be quantified.
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 report	Herring Assessment Working Group for the Area South of 62ºN (HAWG).

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Reference points

	Type	*Value*	*Technical basis*
MSY approach	MSY $B_{escapement}$	142 000 t	Equal to $B_{pa,}$ used in conjunction with F_{cap}.
	F_{cap}	1.2	MSY criteria based on B escapement strategy with an additional constraint on fishing mortality; F_{cap} = 1.2 (ICES, 2014a).
	F_{MSY}	Not defined.	
Precautionary approach	B_{lim}	90 000 t	B_{lim} was set to ensure that years of very good recruitment mainly occurred when the stock was above B_{lim} and years of very low recruitment only occurred when the stock was below B_{lim} (ICES, 2013).
	B_{pa}	142 000 t	$B_{pa} = B_{lim} \times \exp(\sigma \times 1.645)$, with $\sigma = 0.28$ estimated from assessment uncertainty in the terminal year (ICES, 2013).
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	

(last changed in 2014)

Outlook for July 2014 to June 2015

Basis: $F_{2013–2014}$ (July 2013–June 2014) = landings constraint = 0.87; SSB (July 2014) = 369 t; R (GM mean 1992–2013) = 201 billion, catch (July 2013–June 2014) = unknown; landings (July 2013–June 2014) = realized landings and the expected TAC utilization (Q1–Q2 2014)) = 84.

Rationale	Wanted catch (July 2014–June 2015)	Basis	F (July 2014–June 2015)	SSB (July 2015)	% SSB change[1]
MSY approach	227	F_{cap}	1.2	251	−32
Zero catch	0	F = 0	0	350	−5
Other options	167	$F_{2013–2014} \times 0.92$	0.8	276	−25
	178	$F_{2013–2014} \times 1$	0.87	271	−27
	198	$F_{2013–2014} \times 1.15$	1	263	−29
	227	$F_{2013–2014} \times 1.28$	1.2	251	−32
	252	$F_{2013–2014} \times 1.6$	1.4	241	−35
	277	$F_{2013–2014} \times 1.84$	1.6	231	−37

Weights in thousand tonnes.
[1] SSB in July 2015 relative to SSB in July 2014.

MSY approach

The default ICES MSY approach for a short-lived species is an escapement strategy. However, management strategy evaluations for this stock were made in autumn 2013 and presented at WKMSYREF2 (ICES, 2014a). These evaluations clearly show that ICES escapement strategy for short-lived species ($B_{escapement}$) is not precautionary for this stock unless an additional constraint is imposed on the fishing mortality (referred to as F_{cap}). The optimal F_{cap} is 1.2. This means that the fishing mortality derived from the ICES escapement strategy should never exceed 1.2.

Following the ICES MSY approach implies fishing mortality at F_{cap} = 1.2. ICES cannot quantify the resulting catches. The wanted catch should be no more than 227 000 tonnes. There is insufficient information to determine the extent of discarding taking place.

Additional considerations

The fishery for this short-lived species is dominated by 1- and 2-year-old fish. This requires information about incoming 1-year-old fish. In order to provide assessment estimates that are synchronized with the life cycle of sprat, the assessment year is shifted relative to the calendar year from 1 July to 30 June. SSB and recruitment are therefore referenced to 1 July. Hence the 2013 season 1 refers to 2013 quarter 3, and 2013 season 3 refers to 2014 quarter 1(for further detail see ICES, 2013). Figure 6.3.30.5 illustrates how the annual cycle in the assessment model is shifted relative to the calendar year (for further detail see ICES, 2013).

Because discarding and slippage are occurring and unquantified, and the assessment is based on landings, the TAC advice should be considered for landings rather than catches.

Management considerations

The management strategy evaluations for this stock were carried out in autumn 2013 (ICES, 2014a), and resulted in the use of an F_{cap} of 1.2 to ensure the ICES escapement strategy is precautionary. A management plan should be developed for this stock.

ICES provides catch advice for the period July to June in the following year. The TAC at present corresponds to the calendar year (January to December). To ensure that exploitation is consistent with stock status, the TAC year and the advice year should be synchronized.

Considering that a TAC applying to the 2014 calendar year should be provided (with a potential in-year revision), the following information could facilitate using the ICES advice from July 2014 to June 2015: on average during 2010–2012, 84% of the catch was taken during July–December. Applying this percentage to the catch advised for July 2014–June 2015 (227 000 t), a TAC of approximately 191 000 t would be recommended for the period July–December 2014.

The sprat and herring fisheries are linked; therefore, monitoring bycatch of juvenile herring should continue in the sprat fishery. Management measures that address the bycatch of juvenile herring should be revisited. Sprat catches in recent years have been well below the advised and agreed TAC. Management of this stock should consider management advice given for herring in Subarea IV.

Uncertainties in the assessment and forecast

The assessment estimates high CVs for the commercial catches but lower CVs for surveys, indicating that the model is driven mainly by survey indices. There is some concern that the spatial distribution of the biological samples taken from the fishery do not always follow the catch distribution. This represents a problem if there are spatial differences in growth and age composition and may decrease the consistency between years of the cohort's signal in the catches. This may also partially explain why the CVs on the catches are higher than for the survey indices. To remedy the problem, the existing Danish and Norwegian biological samples were used to produce spatially explicit age compositions and weight-at-age whenever the sampling level allowed. Ideally, this should be coupled with total catches per quarter and statistical rectangle. Inclusion of a properly standardized effort index could potentially also represent part of a solution to the problem of high catch CVs.

A large proportion of the population contributes to SSB already at one year of age (before entering the fishery). This means that the estimated value of SSB after the fishery is highly dependent upon the recruitment value used in the forecast. A recruitment index providing indications of the size of the incoming age-0 year class would therefore be an important improvement of the forecast, which currently applies the long-term geometric average recruitment.

Recruitment in the terminal year is relatively uncertain, yet it is the best available information to inform the forecast and the calculation of the TAC. Recruitment in the terminal year is largely estimated by IBTS-Q1, which in 2014 showed the second highest index in the time series.

Comparison of the basis of previous assessment and advice

The basis for the assessment has not changed from last year. This year's advice has changed; it is based on the ICES escapement approach for short-lived species in conjunction with F_{cap}.

Sources

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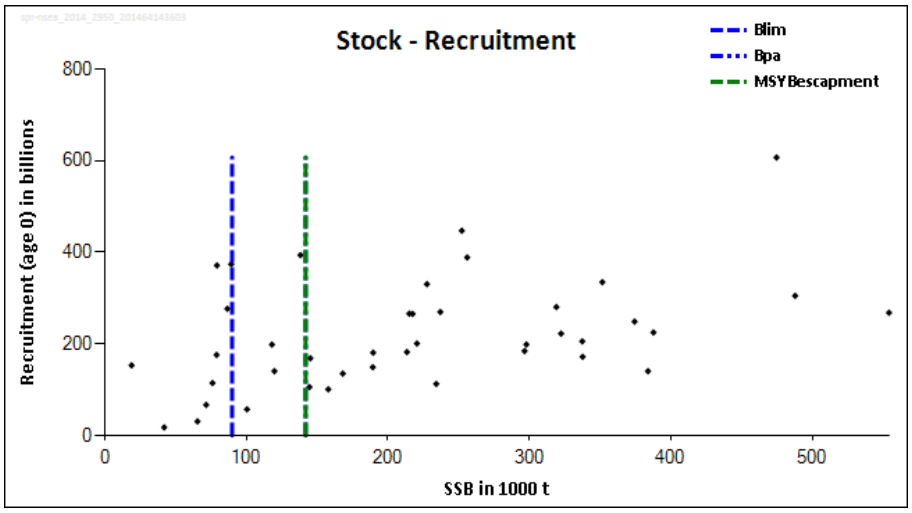

Figure 6.3.30.3 Sprat in Subarea IV (North Sea). Stock–recruitment plot

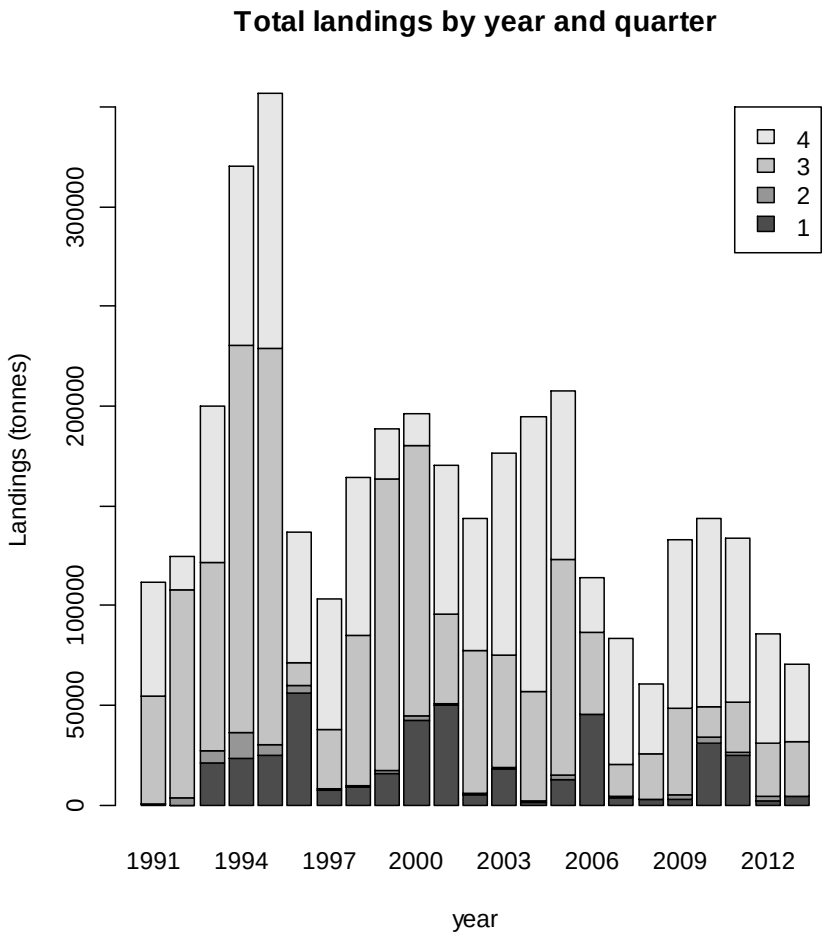

Figure 6.3.30.4 Sprat in Subarea IV (North Sea). ICES landings per quarter (in tonnes).

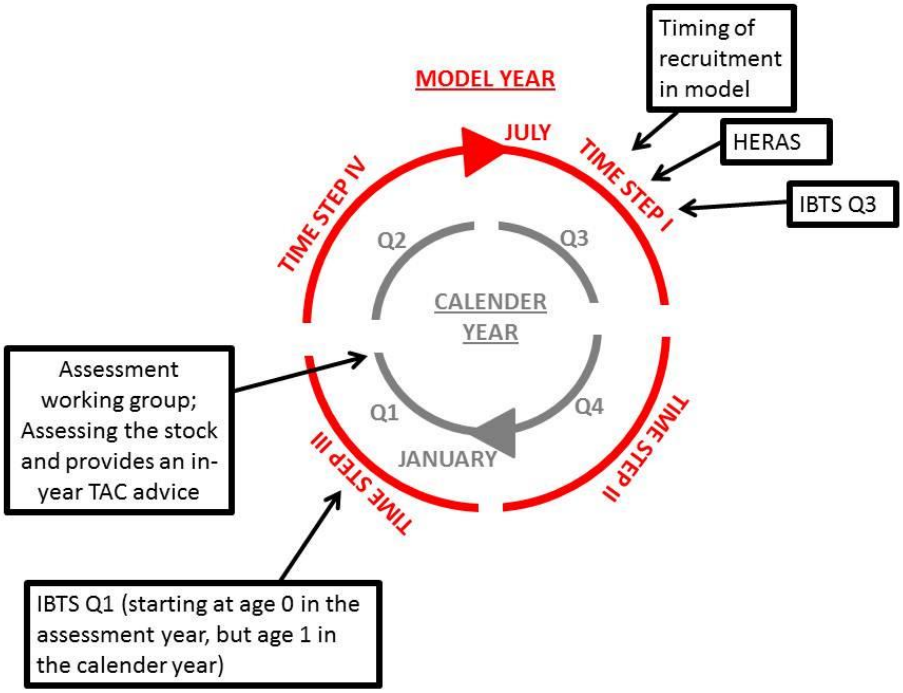

Figure 6.3.30.5 An illustration of how the annual cycle in the assessment model is shifted relative to the calendar year.

Table 6.3.30.1 Sprat in Subarea IV (North Sea). ICES advice, management, catch, and landings.

Year	ICES Advice	Predicted catch corresp. to advice	Agreed TAC[1]	Official catches	ICES landings
1987	Catch at lowest practical level	0	57	78	32
1988	TAC < recent catches, preferably zero	0	57	93	87
1989	No advice	-	59	50	63
1990	No advice	-	59	49	73
1991	No advice	-	55	92	112
1992	No advice	-	55	72	124
1993	No advice	-	114	127	200
1994	No advice for sprat; maintain bycatch regulations	-	114	184	320
1995	No advice	-	175	190	357
1996	No advice	-	200	141	136
1997	Enforce by-catch regulations	-	150	123	103
1998	Limited by restrictions on juvenile herring	-	150	175	163
1999	Limited by restrictions on juvenile herring	-	225	167	188
2000	Limited by restrictions on juvenile herring	-	225	208	196
2001	Catch prediction	225	225	180	170
2002	Catch prediction	160	232	167	144
2003	Catch prediction	175	257	201	177
2004	Catch prediction	171	257	208	194
2005	Catch prediction	244	257	242	206
2006	Catch predictions	< 250	175	135	114
2007	Catch prediction	< 195	175	99	84
2008	Catch prediction	< 170	170	75	61
2009	No advice	-	170	140	133
2010	No advice	-	170	155	143
2011	Reduce catches	-	170	143	134
2012	Reduce catches		162	95	86
In year	No increase in catches (2011)	< 134			
2013*	MSY approach (catches)	< 144	162	70.6	66
2014*	MSY approach (wanted catch)	< 227	123		

Weights in thousand tonnes.

[1] 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.

Table 6.3.30.2 Sprat in Subarea IV (North Sea). ICES landings by area (in tonnes). See ICES (2006b) 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 IVb catches for 2000–2007 divided by Divisions IVbW and IVE can be found in ICES (2008).

Year	Quarter	Area				Total
		IVaW	IVaE	IVb	IVc	
2007	1			582	247	829
	2			241	3	244
	3			16603		16603
	4	769		41850	23531	66150
	Total	769		59276	23781	83826
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
2013	1			1281	3158	4438
	2			32	0	32
	3			25577	720	26297
	4			18892	16276	35167
	Total	0	0	45781	20154	65934

* < 0.5 tonnes.

Table 6.3.30.3 Sprat in Subarea IV (North Sea). Summary of the assessment.

Year	Recruitment			SSB			Landings	Mean F		
	Age 0							Ages		
	thousands	High	Low	tonnes	High	Low	tonnes	1–2	High	Low
1974	268249000	340072000	196428000	554352	696590	412110	379883	0.991	1.26	0.722
1975	607167000	768280000	446060000	474831	585990	363670	607849	1.493	1.74	1.247
1976	305200000	385111000	225289000	487976	606300	369660	701782	1.113	1.347	0.879
1977	334989000	425058000	244922000	351734	428118	275342	335306	1.543	1.821	1.266
1978	447277000	564390000	330170000	252375	310180	194580	489316	1.582	1.843	1.321
1979	248721000	315837000	181603000	374467	463100	285840	484624	1.529	1.795	1.262
1980	269763000	339072000	200448000	237217	289218	185222	483279	1.488	1.758	1.219
1981	100941000	131058000	70822000	157965	192652	123288	201840	1.389	1.66	1.118
1982	57045000	71175000	42915000	100569	123352	77788	127212	0.845	1.056	0.633
1983	66997000	83864000	50130000	71600	86528	56672	67486	1.671	1.945	1.398
1984	30914000	38584900	23243100	65472	79691	51253	68416	1.052	1.293	0.811
1985	17625000	21812400	13437600	41937	50510	33364	39458	1.437	1.701	1.173
1986	153316000	188103000	118537000	18913	22559	15267	20659	1.091	1.356	0.827
1987	114683000	143924000	85436000	76110	92663	59557	42156	0.422	0.548	0.297
1988	371364000	481570000	261150000	79257	94390	64124	86481	0.256	0.378	0.135
1989	135176000	168972000	101388000	168190	212267	124113	63698	0.079	0.116	0.043
1990	140491000	172012000	108968000	119867	145210	94530	89571	2.285	2.544	2.026
1991	276793000	339489000	214091000	86654	104213	69095	84649	0.616	0.77	0.463
1992	265674000	323138000	208202000	217558	261645	173475	153649	0.746	0.935	0.556
1993	388867000	473081000	304659000	256182	303016	209344	234265	1.853	2.099	1.606
1994	198728000	240974000	156486000	298060	356150	239970	398697	0.929	1.127	0.732
1995	105712000	128284000	83136000	144691	174277	115103	416538	1.372	1.596	1.149
1996	198515000	242946000	154074000	118205	138203	98217	83634	0.604	0.743	0.464
1997	205719000	249209000	162231000	337477	405018	269942	90316	0.625	0.776	0.473
1998	280560000	342287000	218833000	319276	376224	262336	161433	1.195	1.372	1.017
1999	265986000	327463000	204517000	215303	255443	175157	220736	0.599	0.729	0.468
2000	184542000	225279000	143801000	296739	353092	240388	179540	0.763	0.972	0.553
2001	149089000	178066000	120114000	189400	223314	155486	110442	1.489	1.689	1.288
2002	175956000	208067000	143853000	78994	92413	65575	144265	1.39	1.571	1.208
2003	180947000	214092000	147808000	189631	221927	157333	131255	0.919	1.084	0.754
2004	374158000	441154000	307166000	89282	103248	75316	229197	1.68	1.856	1.503
2005	140560000	166749000	114371000	384038	450177	317903	257645	0.787	0.922	0.652
2006	182301000	215311000	149289000	213540	250321	176759	70750	0.797	0.974	0.62
2007	168745000	197830000	139650000	145259	167737	122783	78730	1.237	1.402	1.071
2008	330692000	389446000	271934000	227690	263784	191596	65598	0.684	0.846	0.523
2009	225120000	266895000	183345000	387907	450473	325347	175282	0.422	0.533	0.311
2010	222472000	261661000	183279000	322516	373314	271726	161814	0.456	0.57	0.343
2011	171974000	205387000	138553000	337820	389976	285664	111200	0.791	0.953	0.63
2012	112722000	138432000	87008000	234283	272174	196386	85627	0.383	0.552	0.215
2013	393900000	571690000	216110000	138314	163418	113202	84014	0.812	1.008	0.616
2014	201000000			369000*						
Average	221235366	274645633	168836418	225138	265722	177362	200457	1.035	1.231	0.84

* Average mean weight and maturity (2011–2013).