

Sandeel (*Ammodytes* spp.) in divisions 4.a–b, Sandeel Area 4 (northern and central North Sea)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 59 345 tonnes.

Stock development over time

Fishing mortality (F) has been very low since 2006. Spawning-stock biomass (SSB) has increased from the time-series low in 2009 to levels well above precautionary reference points ($B_{pa} = MSY B_{escapement}$) and has remained at this level since 2011, with one exception (2015). The 2016 and 2017 year classes are estimated to be above the long-term average.



Figure 1 Sandeel in divisions 4.a–b, Sandeel Area 4. Historical development of the stock from the summary of the stock assessment, with 90% confidence intervals. Predicted values are not shaded.

Stock and exploitation status

Table 1 Sandeel in divisions 4.a–b, Sandeel Area 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}	?	?	?	Unknown	MSY	✓
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Unknown	B_{pa}, B_{lim}	✓
Management plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-
							✓ Above escapement
							✓ Full reproductive capacity
							- Not applicable

Catch scenarios

Table 2 Sandeel in divisions 4.a–b, Sandeel Area 4. The basis for the catch scenarios.

Variable	Value	Notes
F (2017)	0.047	Sum of half-yearly Fs
Recruitment (2017)	192 768 395	In thousands
Recruitment (2018)	72 199 565	Geometric mean (2007–2016), in thousands
SSB (2018)	194 658	In tonnes

Table 3 Sandeel in divisions 4.a–b, Sandeel Area 4. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2018)	F _{total} (2018)	SSB (2019)	% SSB change *	% TAC change **	% advice change ***
ICES advice basis						
SSB ₂₀₁₉ ≥ MSY B _{escapement} with F _{cap}	59345	0.15	200311	+3%	+10%	+10%
Other scenarios						
F = 0	0	0	233648	+20%	-100%	-100%
SSB ₂₀₁₉ = MSY B _{escapement} = B _{pa}	244468	0.841	102000	-48%	+353%	+353%
B _{lim}	360304	1.677	48000	-75%	+567%	+567%
F = F ₂₀₁₇	19572	0.047	222580	+14%	-64%	-64%

* SSB 2019 relative to SSB 2018.

** Catch scenario for 2018 relative to TAC in 2017.

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

Basis of the advice

Table 4 Sandeel in divisions 4.a–b, Sandeel Area 4. The basis of the advice.

Advice basis	MSY approach (Escapement strategy with F _{cap})
Management plan	ICES is not aware of any agreed precautionary management plan for sandeel in this area.

Quality of the assessment

Fishing mortality has been very low since the mid 2000s, which increases uncertainty around SSB (ICES, 2018). However, the probability that SSB has been above MSY B_{escapement} in recent years is high.

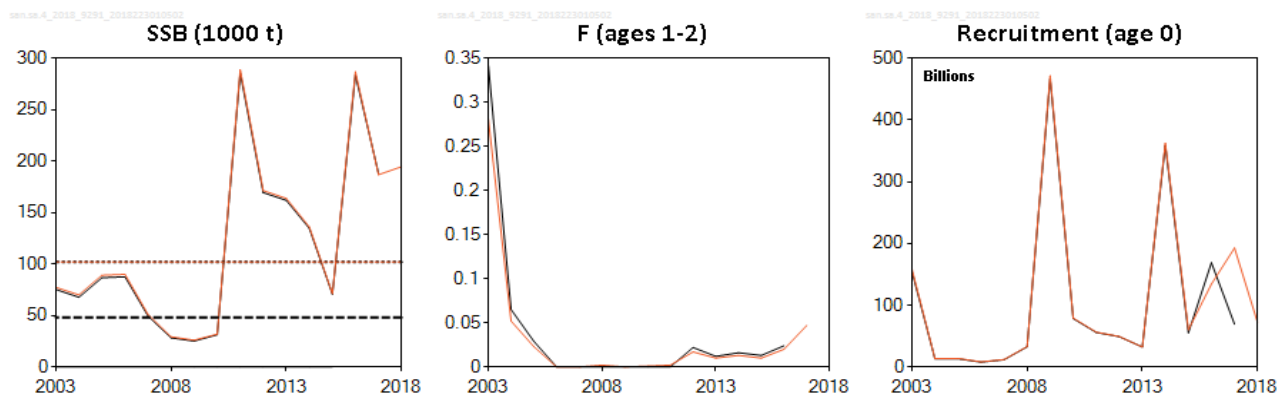


Figure 2 Sandeel in divisions 4.b–c, Sandeel Area 4. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

The catch advice figures for 2017 and 2018 are much higher than the catches realized in recent years. While parts of the sandeel banks in Sandeel Area 4 (SA 4) are closed for fisheries (STECF, 2007), the assessment and reference points are based on the entire stock, i.e. including those sandeels that are distributed in the closed areas. An exchange of sandeels does take place between the closed and open banks in SA 4, but sandeel movement is limited.

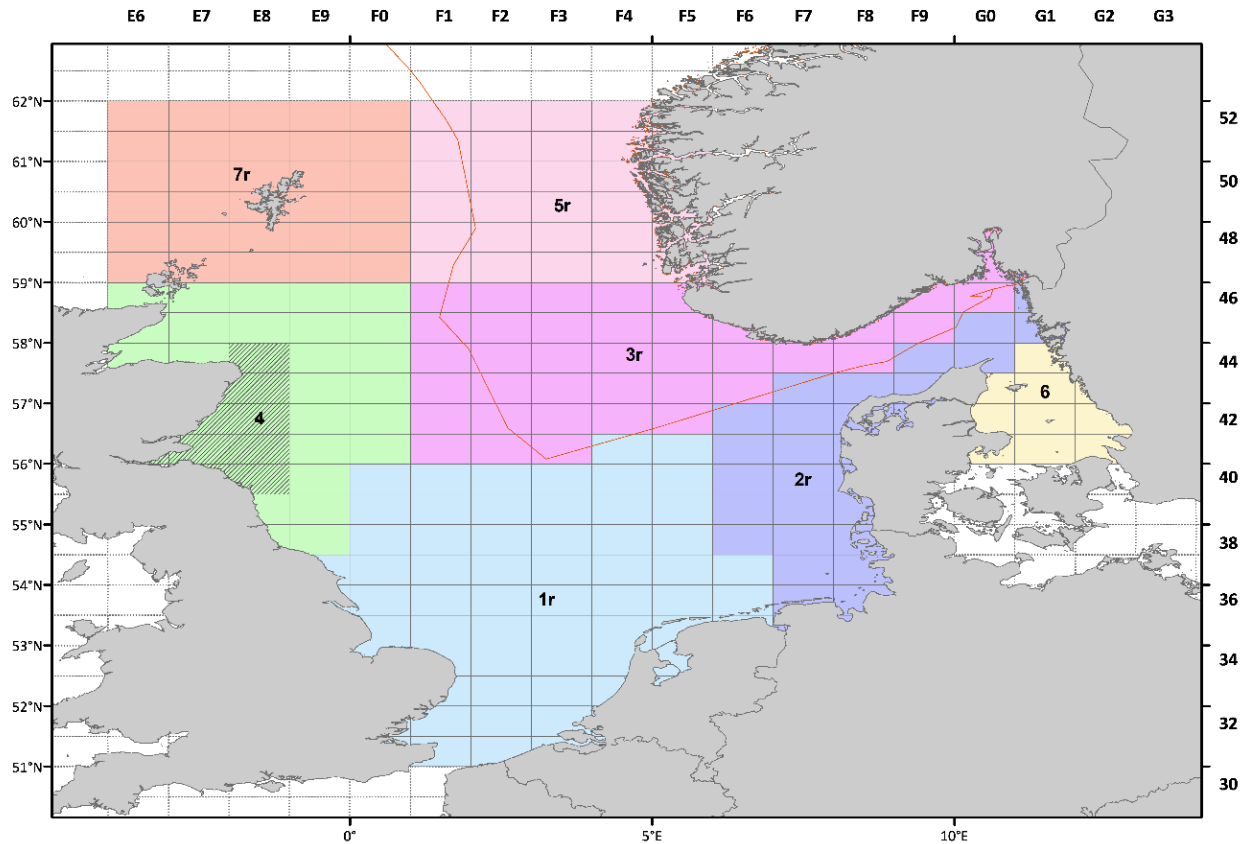


Figure 3 Sandeel in divisions 4.a–b, Sandeel Area 4. Stock areas for the seven sandeel stocks. The Norwegian Exclusive Economic Zone (EEZ) is shown as a red line. The closed area in sandeel area 4 is shown with hatched markings.

Reference points

Table 5 Sandeel in divisions 4.a and 4.b, Sandeel Area 4. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{escapement}}$	102000 t	$= B_{\text{pa}}$	ICES (2017)
	F_{MSY}	Not defined		
	F_{cap}^*	0.15	The maximum F estimated from MSE that results in less than 5% probability of $SSB < B_{\text{lim}}$.	ICES (2017)
Precautionary approach	B_{lim}	48000 t	Average SSB of the two lowest SSB estimates that provide high recruitment (2003, 2009).	ICES (2017)
	B_{pa}	102000 t	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$, with $\sigma = 0.46$ estimated from the assessment uncertainty in the terminal year.	ICES (2017)
	F_{lim}	Not defined		
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

* Not used as a biological reference point, but used in the ICES MSY approach for stocks of short-lived species.

Basis of the assessment

Table 6 Sandeel in divisions 4.a and 4.b, Sandeel Area 4. The basis of the assessment.

ICES stock data category	1 (ICES, 2016a).
Assessment type	Age-structured model (SMS-effort), seasonal (ICES, 2018).
Input data	One survey index available in January (dredge survey). Total international catch and fishing effort. Fixed maturity data. Natural mortality estimated from multispecies assessment (assumed constant over time; ICES, 2016b). Age frequencies from catch sampling.
Discards and bycatch	Discarding is considered to be negligible.
Indicators	None.
Other information	Last benchmarked in 2016 (ICES, 2017).
Working group	Herring Assessment Working Group (HAWG)

Information from stakeholders

There is no additional available information for this stock.

History of advice, catch, and management

Table 7 Sandeel in divisions 4.a–b, Sandeel Area 4. History of ICES advice, the agreed TAC, and ICES estimates of catch. All weights are in tonnes. Values of catch for the period 2005 to 2015 are presented to the nearest thousand tonnes.

Year	ICES advice	Catch corresponding to advice	TAC	ICES catch SA 4	Total ICES catch (SAs 1r–7r)
2005*	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class.	-	661000**	1557	177000
2006*	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300000**	55	293000
2007*	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173000**	11	230000
2008*	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2009.	-	375000**	1168	348000
2009*	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2010.	-	377000**	0	353000
2010*	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to B_{pa} by 2011.	-	377000**	275	414000
2011	A TAC at 5000–10 000 tonnes will impose a low risk of overfishing sandeel in this area.	5000–10000	10000	272	438000
2012	Catches for monitoring purposes should not exceed 5000 t.	< 5000	5000	2585	102000
2013	Catch of 2012 reduced by 20% as a precautionary buffer.	< 2041	4000	5225	278000
2014	Catches for monitoring purposes should not exceed 5000 t (with associated sampling protocol).	< 5000	5000	4414	264000
2015	Catches for monitoring purposes should not exceed 5000 t (with associated sampling protocol).	< 5000	5000	4392	312000
2016	Precautionary approach	≤ 6000	6000	6188	75405
2017	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment.	≤ 54043	54043	17504***	518410***
2018	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment.	≤ 59345			

* Advice for Subarea 4, excluding the Shetland area.

** Set for EU waters of divisions 2.a and 3.a and Subarea 4.

*** Preliminary.

History of catch and landings

Table 8 Sandeel in divisions 4.a–b, Sandeel Area 4. Catch distribution by fleet in 2017 as estimated by ICES (in tonnes).

Total catch (2017)	Landings	Discards
17 504	100% industrial trawl fisheries	Negligible
	17 504	

Table 9 Sandeel in divisions 4.a–b, Sandeel Area 4. History of total catch (in tonnes) as estimated by ICES.

Year	Catch
1983	2782
1984	2563
1985	38122
1986	12718
1987	8154
1988	1338
1989	4384
1990	3314
1991	41372
1992	68905
1993	133136
1994	158690
1995	52591
1996	158490
1997	58446
1998	58746
1999	53334
2000	37792
2001	47918
2002	12761
2003	64048
2004	6882
2005	1557
2006	86
2007	11
2008	1168
2009	0
2010	275
2011	272
2012	2585
2013	5225
2014	4414
2015	4392
2016	6195
2017	17504

Summary of the assessment

Table 10 Sandeel in divisions 4.a–b, Sandeel Area 4. Assessment summary. The SSB is estimated for 1 January. Catch values used for the assessment do not include catches of age 0 in the first half of the year and, hence, may differ slightly from the ICES catch estimates presented in other tables. Zero catch denotes years with very low catches in which there was no biological sampling of the fishery.

Year	Recruitment (Age 0)	High	Low	SSB	High	Low	Catches	F ages 1–2	High	Low
	thousands			tonnes			tonnes	Per year		
1993	119043556	194361084	72912581	381170	603112	240901	132599	0.351	0.591	0.208
1994	268671500	453053017	159328758	165877	305411	90092	158690	0.403	0.679	0.239
1995	72131399	122514664	42467885	135673	261535	70381	52591	0.113	0.19	0.067
1996	394054586	675004232	230041545	269144	474851	152549	158490	0.343	0.586	0.201
1997	102154814	190064609	54905571	90400	187560	43571	58446	0.155	0.262	0.092
1998	45763620	84011800	24928747	278452	504882	153571	58746	0.156	0.263	0.092
1999	248511579	427975192	144302769	211082	396898	112259	53334	0.22	0.37	0.13
2000	211133248	359352369	124048851	93807	200140	43968	37714	0.109	0.183	0.064
2001	25597366	44711410	14654540	123254	229713	66132	47902	0.172	0.291	0.102
2002	92525977	159824381	53565398	136216	256095	72453	12736	0.036	0.061	0.021
2003	159093080	289490819	87431471	77343	143298	41744	63731	0.281	0.474	0.167
2004	13537850	44394607	4128280	70052	146602	33474	6882	0.052	0.088	0.031
2005	13880562	***	***	89143	166550	47712	1557	0.023	0.038	0.014
2006	8129419	***	***	90039	167995	48258	0	0	0.001	0
2007	11911323	27900607	5085180	51072	146477	17807	0	0	0	0
2008	32966419	71268498	15249161	29231	118138	7233	0	0.002	0.003	0.001
2009	471768992	1009860949	220392701	26030	86073	7872	0	0	0	0
2010	79240651	164412516	38191015	31888	71151	14292	0	0.001	0.002	0.001
2011	56344771	116069591	27351981	288947	613763	136031	0	0.002	0.003	0.001
2012	49327880	102508054	23737059	171442	353814	83073	2585	0.017	0.029	0.01
2013	32249078	67433575	15422629	163898	337689	79548	5225	0.01	0.016	0.006
2014	362668590	742706402	177093540	136080	276732	66916	4314	0.013	0.022	0.008
2015	60128831	123864712	29188913	71254	144915	35035	4392	0.01	0.017	0.006
2016	134221234	278072440	64786499	286932	581624	141552	6188	0.02	0.034	0.012
2017	192768395	450057294	82566497	186839	377673	92431	17504	0.047	0.079	0.028
2018	72199565*			194658**	399538	94839				
Average	128077857	269517949	68475478	148074	290470	76681	35345	0.101	0.171	0.06

* Geometric mean (2007–2016).

** Mean weight-at-age (2013–2017).

*** Extremely wide confidence limits estimated by the model.

Sources and references

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