

Sandeel (*Ammodytes* spp.) in divisions 4.a–b and Subdivision 20, Sandeel Area 3r (northern and central North Sea, Skagerrak)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2018 should be no more than 108 365 tonnes.

Stock development over time

The spawning-stock biomass (SSB) is increasing and has been above $B_{pa} = MSY B_{escapement}$ since 2015. Recruitment (R) in 2016 was among the highest, whereas recruitment in 2017 was very low. Fishing mortality (F) declined in the early 2000s and has fluctuated at a lower level since.

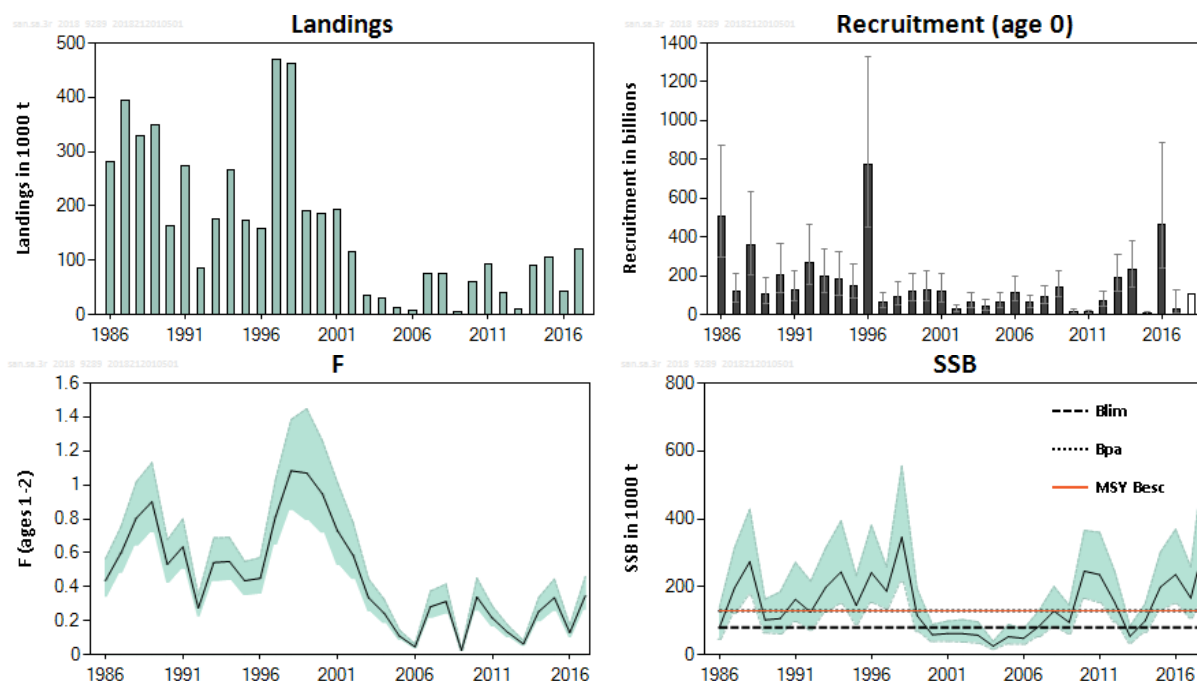


Figure 1 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Historical development of the stock from the summary of the stock assessment, with 90% confidence intervals. Predicted values are not shaded.

Stock and exploitation status

Table 1 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. 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	$MSY B_{escapement}$	✓ ✓ ✓ Above escapement
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Unknown	B_{pa}, B_{lim}	✓ ✓ ✓ Full reproductive capacity
Management plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	- - - Not applicable

Catch scenarios

Table 2 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. The basis for the catch scenarios.

Variable	Value	Notes
F (2017)	0.35	Sum of half-yearly Fs
Recruitment (2017)	29 414 550	From assessment (in thousands)
Recruitment (2018)	105 461 730	Geometric mean 1986–2016 (in thousands)
SSB (2018)	339 762	In tonnes (using geometric mean recruitment in 2018)

Table 3 Sandeel in divisions and 4.a–b and Subdivision 20, Sandeel Area 3r. 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}	108365	0.29	179896	-47%	-10%	46%
Other scenarios						
F = 0	0	0	247786	-27%	-100%	-100%
SSB ₂₀₁₉ ≥ MSY B _{escapement}	192793	0.6	129000	-62%	61%	160%
B _{lim}	278847	1.06	80000	-76%	132%	276%
F ₂₀₁₇	125739	0.35	169252	-50%	4%	70%

* SSB₂₀₁₉ relative to SSB₂₀₁₈.

** Catch scenario for 2018 relative to TAC in 2017 (120 000 t).

*** Advice value 2019 relative to advice value 2018.

The large change in the advice from year to year can be explained by the marked interannual variability in biomass and recruitment and the early maturation, both of which are typical of a short-living species. Recruitment in 2016 is high and contributes to the increase in catch advice for 2018.

Basis of the advice

Table 4 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. 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

In the past there have been large downward revisions of some strong year classes. This is not a cause of concern for the current assessment because the 2017 year class is estimated to be low (ICES, 2018).

Figure 2 reflects changes in the stock assessment as agreed at the benchmark in 2016.

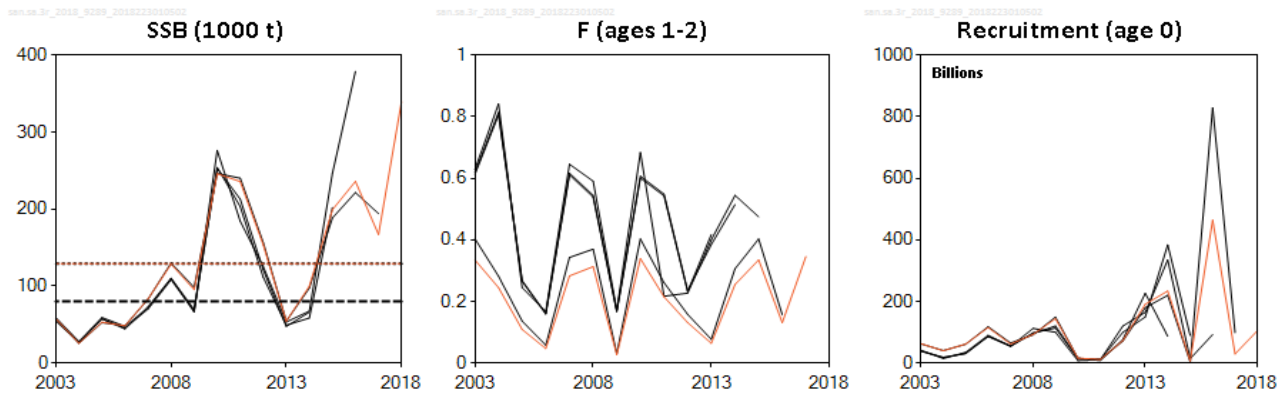


Figure 2 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

Despite the low recruitment in 2017 the survivors of the large 2016 year class are expected to provide the basis for the fishery in 2018. ICES provides advice for this stock according to the MSY approach; however, most of this area is within the Norwegian EEZ and fisheries are managed by alternately opening and closing areas (ICES, 2017). ICES has not evaluated this management measure.

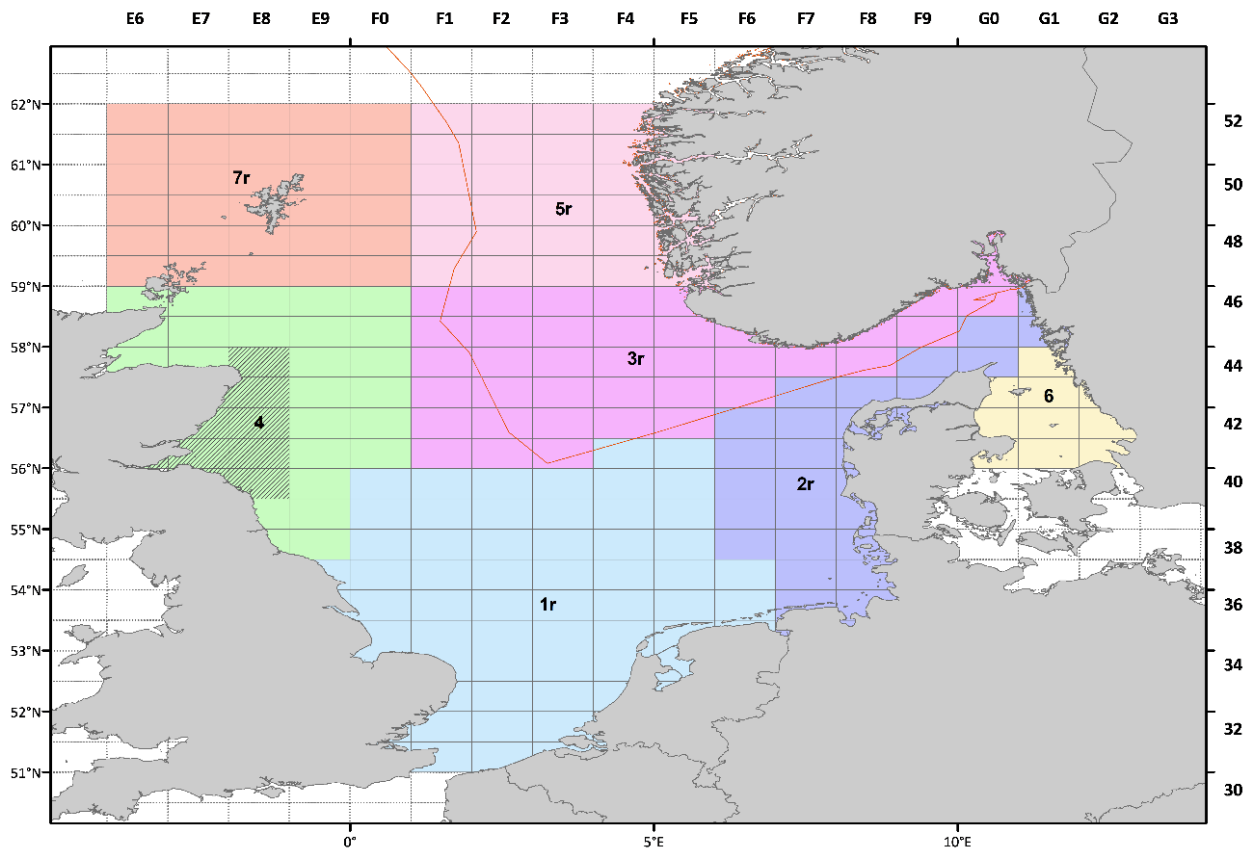


Figure 3 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Stock areas for the seven sandeel stocks. The Norwegian Exclusive Economic Zone (EEZ) is shown as a red line. The closed area in sandeel area 4 is shown with hatched markings.

Reference points

Table 5 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{escapement}}$	129 000 t	= B_{pa}	ICES (2017)
	F_{MSY}	Not defined		
	F_{cap} *	0.29	Maximum F estimated from MSE that results in less than 5% probability of $SSB < B_{\text{lim}}$.	ICES (2017)
Precautionary approach	B_{lim}	80 000 t	The lowest SSB at which a high recruitment is observed.	ICES (2017)
	B_{pa}	129 000 t	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$, with $\sigma = 0.29$ 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–b and Subdivision 20, Sandeel Area 3r. The basis of the assessment and advice.

ICES stock data category	1 (see ICES, 2016a).
Assessment type	Age-structured model (SMS-effort), seasonal (ICES, 2018).
Input data	Acoustic survey index (2009–2017) and dredge survey index (2005–2017). Total international catch and fishing effort. Constant maturity-at-age estimated from the dredge survey. Natural mortality estimated from multispecies assessment (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 and 4.a–b and Subdivision 20, Sandeel Area 3r. 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	EU zone TAC	Norwegian zone TAC	ICES catch SA 3	ICES catch SA 3r	Total ICES catch (SAs 1r–7r)
2005*	Exploitation to be kept below the level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class.	-	661000**	10000***	30000		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**	0	19000		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**	51000	114000		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**	128000	95000		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	34000		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**	50000	81000		414000
2011	No fishery	0	10000	90000	95000		438000
2012	Catches for monitoring purposes should not exceed 5 000 t.	< 5000	5000	42000	46000		102000
2013	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment.	< 78331	40000	20000	39000		278000
2014	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment.	< 270000	140000	90000	143000		264000
2015	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment, with additional F_{cap} .	< 370000	190000	100000	122000		312000
2016	MSY approach: allow for sufficient stock ($MSY B_{escapement}$) to remain for successful recruitment.	≤ 123135	63000	40000	50737	44076	75405

Year	ICES advice	Catch corresponding to advice	EU zone TAC	Norwegian zone TAC	ICES catch SA 3	ICES catch SA 3r	Total ICES catch (SAs 1r–7r)
2017 [^]	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	≤ 74176		120000		120933 ^{^^}	518410 ^{^^}
2018 [^]	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	≤ 108365					

* Advice for Subarea 4, excluding the Shetland area.

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

*** TAC set for EU fisheries 10 kt; seasonal effort limitations set for Norwegian fisheries.

[^] ICES statistical rectangles included in this sandeel area have changed in the 2017 assessment and advice.

^{^^} Preliminary.

History of catch and landings

Table 8 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Catch distribution by fleet in 2017 as estimated by ICES (in tonnes).

Total catch (2017)	Landings	Discards
120 933	100% industrial trawl fisheries	Negligible
	120 933	

Table 9 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. History of total catch (in tonnes) as estimated by ICES.

Year	Catch
1982	45648
1983	24828
1984	49111
1985	20859
1986	282334
1987	395298
1988	336919
1989	374252
1990	163224
1991	274839
1992	87022
1993	200123
1994	267281
1995	213168
1996	159304
1997	474093
1998	469183
1999	145159
2000	196177
2001	150534
2002	116007
2003	33788
2004	30496
2005	13994
2006	7008
2007	75391
2008	74992

Year	Catch
2009	6362
2010	61243
2011	92452
2012	40134
2013	9844
2014	95464
2015	104631
2016	44076
2017	120933

Summary of the assessment

Table 10 Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Assessment summary with weights (in tonnes) and recruits (at age 0, in thousands). 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.

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Catches	F ages 1–2	High	Low
	thousands			tonnes			tonnes	Per year		
1986	509021086	871436683	297327931	79698	138541	45848	282315	0.437	0.565	0.337
1987	117154016	209906150	65386666	196614	315207	122641	395296	0.599	0.753	0.477
1988	360859773	633188996	205657042	274032	428197	175371	330358	0.806	1.019	0.638
1989	106323831	189177495	59757409	102539	163469	64320	350409	0.9	1.131	0.717
1990	205508921	365064333	115688969	106511	185070	61298	163224	0.533	0.677	0.42
1991	124025779	226004461	68062347	163081	272087	97746	274839	0.634	0.8	0.501
1992	266264305	462761343	153203549	125367	216570	72572	86788	0.276	0.347	0.22
1993	194122508	339596649	110965606	198988	314790	125786	175786	0.543	0.688	0.429
1994	182634966	326148912	102270864	243531	394049	150508	267281	0.549	0.691	0.436
1995	146861423	262947179	82025134	145219	232727	90615	173607	0.436	0.549	0.347
1996	772389875	1326328689	449802620	241591	380892	153235	159024	0.45	0.572	0.355
1997	62457695	111062544	35124026	187025	257504	135837	470670	0.817	1.036	0.645
1998	94868284	168354208	53458665	345933	556025	215223	462081	1.083	1.385	0.847
1999	120721887	211819829	68802689	115266	193850	68539	191253	1.07	1.449	0.79
2000	126152241	226982232	70112924	58924	89313	38874	186837	0.95	1.263	0.715
2001	119999724	214517306	67127142	62380	98975	39316	193684	0.728	1.011	0.524
2002	28064051	52241334	15076012	62193	103233	37469	116298	0.586	0.778	0.441
2003	62959360	115067136	34448420	57699	96859	34372	34673	0.335	0.446	0.251
2004	39824784	75337546	21052099	25540	39448	16535	31285	0.245	0.327	0.183
2005	61651000	111738254	34015618	53104	89191	31617	13991	0.109	0.145	0.082
2006	115179231	194767329	68113349	48388	75770	30901	7094	0.047	0.063	0.035
2007	61589379	101486899	37376762	83200	128965	53675	74972	0.283	0.375	0.213
2008	92896823	151123695	57104345	128541	200786	82290	74933	0.313	0.416	0.236
2009	143809491	227526149	90895793	95320	145807	62315	6261	0.027	0.035	0.02
2010	15886814	27774464	9087155	245979	366004	165314	61241	0.339	0.451	0.255
2011	11640489	19869753	6819460	235861	360464	154330	92452	0.215	0.286	0.162
2012	73002190	123818406	43041418	153737	244839	96533	40116	0.131	0.173	0.098
2013	191041263	307347316	118747626	54339	84117	35103	9844	0.064	0.084	0.048

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Catches	F ages 1–2	High	Low
	thousands			tonnes			tonnes	Per year		
2014	234039392	382547466	143183374	99808	150115	66359	90876	0.255	0.338	0.192
2015	6655805	12306726	3599637	199187	301813	131457	104631	0.335	0.446	0.252
2016	464280754	887557904	242864851	236097	369468	150871	42845	0.131	0.173	0.098
2017	29414550	125731025	6881482	167042	258364	107999	120933	0.346	0.46	0.26
2018	105461730**			339762*	626627	184221				
Average	158992831	283173075	91783781	149470	238762	93912	158934	0.455	0.592	0.351

* Using mean weight-at-age from 2013 to 2017.

** Geometric mean (1986–2016).

Sources and references

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