

Sandeel (*Ammodytes* spp.) in divisions 4.b–c, Sandeel Area 1r (central and southern North Sea, Dogger Bank)

ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2019 should be no more than 91 916 tonnes.

Stock development over time

The spawning-stock biomass (SSB) was below B_{lim} and $B_{pa} = MSY B_{escapement}$ at the beginning of 2019. Recruitment (R) in 2018 was slightly above the geometric mean of the time-series, following the lowest historical recruitment in 2017. Fishing mortality (F) has fluctuated, showing a declining trend since the mid-2000s followed by an increase in 2017 and 2018 to approximately the long-term average.

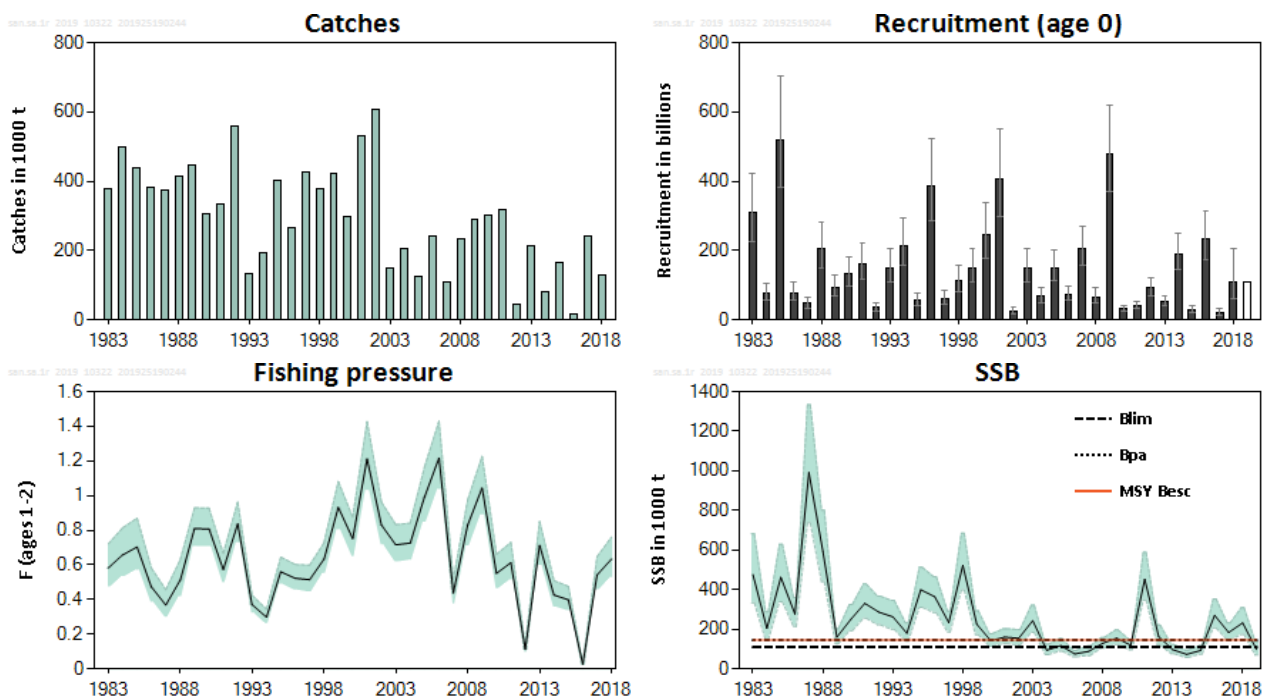


Figure 1 Sandeel in divisions 4.b–c, Sandeel Area 1r. Historical development of the stock from the summary of the stock assessment, with 90% confidence intervals. Predicted values are not shaded.

Stock and exploitation status

ICES assesses that the spawning stock size is below $MSY B_{escapement}$ and below B_{pa} and B_{lim} . No reference points for fishing pressure have been defined for this stock.

Table 1 Sandeel in divisions 4.b–c, Sandeel Area 1r. State of the stock and fishery relative to reference points.

	Fishing pressure				Stock size				
		2016	2017	2018	2017	2018	2019		
Maximum sustainable yield	F_{MSY}	?	?	?	Undefined	MSY $B_{escapement}$	✓	✓	✗ Below escapement
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Undefined	B_{pa}, B_{lim}	✓	✓	✗ Reduced reproductive capacity
Management plan	F_{MGT}	—	—	—	Not applicable	B_{MGT}	—	—	— Not applicable

Catch scenarios

Table 2 Sandeel in divisions 4.b–c, Sandeel Area 1r. The basis for the catch scenarios.

Variable	Value	Notes
F (2018)	0.63	From the assessment
Recruitment (2018)	110 773 707	From the assessment; in thousands
Recruitment (2019)	107 870 298	Geometric mean 1983–2017; in thousands
SSB (2019)	97 636	Tonnes

Table 3 Sandeel in divisions 4.b–c, Sandeel Area 1r. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2019)	F _{total} (2019)	SSB (2020)	% SSB change *	% TAC change **	% advice change ***
Ices advice basis						
SSB ₂₀₂₀ ≥ MSY B _{escapement}	91916	0.395	145001	+49%	-32%	-32%
Other scenarios						
F = 0	0	0	206479	+111%	-100%	-100%
SSB ₂₀₂₀ = MSY B _{escapement} = B _{pa}	91916	0.395	145001	+49%	-32%	-32%
B _{lim}	148390	0.764	110000	+13%	+10%	+10%
F = F ₂₀₁₈	130568	0.633	120774	+24%	-3%	-3%

* SSB₂₀₂₀ relative to SSB₂₀₁₉.

** Catch scenario for 2019 relative to TAC in 2018 (134 461 t).

*** Advice value 2019 relative to advice value 2018 (134 461 t).

The large change in the advice from year to year can be explained by the marked interannual variability of biomass and recruitment as well as the early maturation, both of which are typical for a short-living species. Stock size at the beginning of 2019 is estimated to be below B_{lim} and this has contributed to the reduction in advised catch for 2019.

Basis of the advice

Table 4 Sandeel in divisions 4.b–c, Sandeel Area 1r. The basis of the advice.

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

Quality of the assessment

The uncertainties in the estimates of SSB, F, and recruitment are low.

The area covered by the dredge survey was expanded in 2017 (ICES, 2018a), which should improve the quality of the assessment.

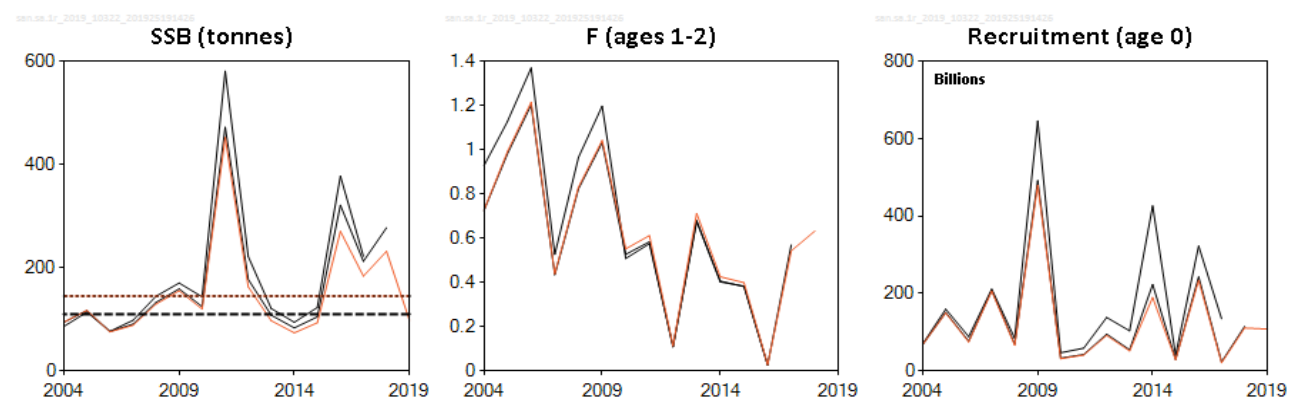


Figure 2 Sandeel in divisions 4.b–c, Sandeel Area 1r. Historical assessment results (final-year recruitment estimates included).

Issues relevant for the advice

The stock size at the beginning of 2019 is estimated to be more than 47 000 t below $B_{\text{escapement}}$. This, in combination with the recent low weight of age 1 fish, contributes to a decrease in the advised catch despite the average recruitment.

The reported catches from this area in 2014 and 2015 were revised in 2017, based on information from vessel monitoring systems and previous catch distributions, in order to account for substantial misreporting of catches in the area. Based on the misreporting of catches as observed in 2014, management measures to avoid area misreporting (only one fishing area per trip) have been mandatory for the Danish fishery since 2015. This is not the case for other countries.

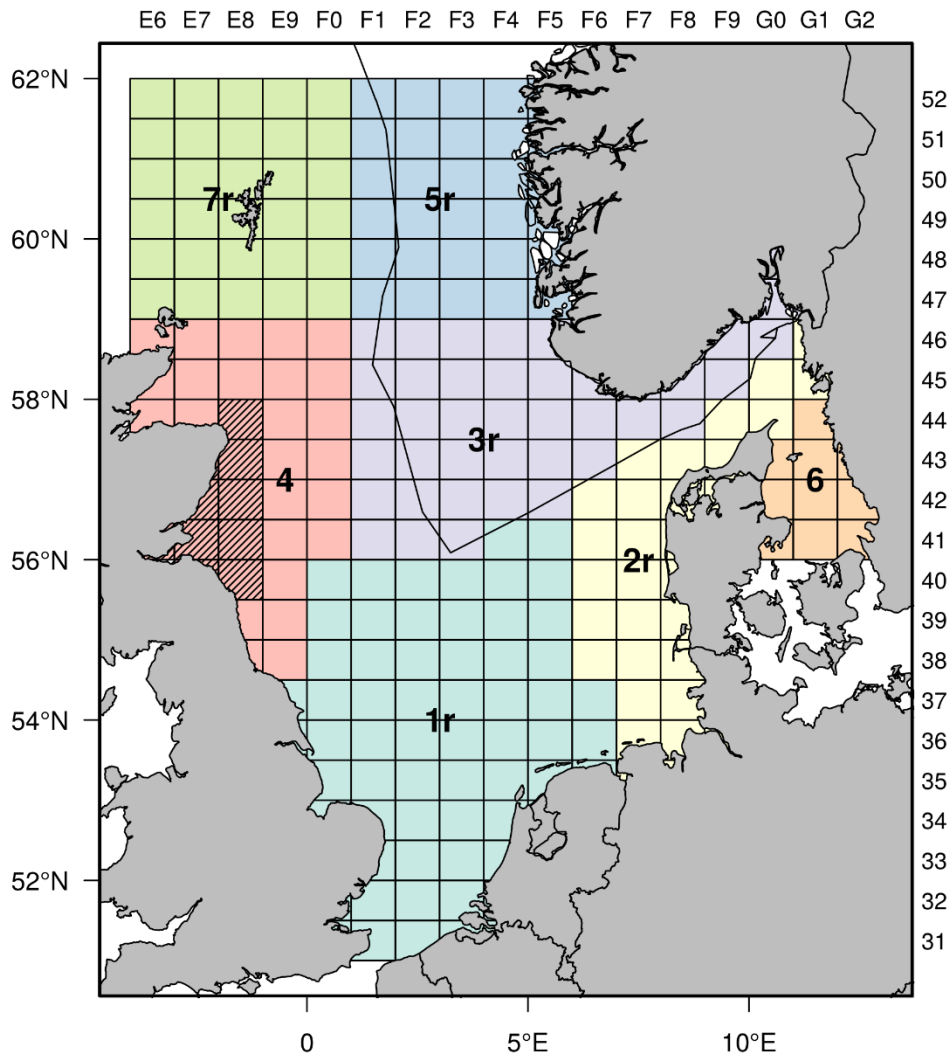


Figure 3 Sandeel in divisions 4.b–c, Sandeel Area 1r. Stock areas for the seven sandeel stocks. The border of the Norwegian Exclusive Economic Zone (EEZ) is also shown. The closed part of Sandeel Area 4 is shown with hatched markings.

Reference points

Table 5 Sandeel in divisions 4.b–c, Sandeel Area 1r. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{escapement}}$	145 000 t	= B_{pa}	ICES (2017)
	F_{MSY}	Not defined		
	F_{cap}^*	0.49	Maximum F, estimated from MSE, resulting in less than 5% probability of $SSB < B_{\text{lim}}$.	ICES (2017)
Precautionary approach	B_{lim}	110 000 t	The lowest SSB at which a high recruitment is observed.	ICES (2017)
	B_{pa}	145 000 t	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$, with $\sigma = 0.17$ 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.b–c, Sandeel Area 1r. The basis of the assessment and advice.

ICES stock data category	1 (see ICES, 2018b).
Assessment type	Age-structured model (SMS-effort), half-yearly time-steps (ICES, 2019).
Input data	One survey index in December (dredge survey since 2004) and commercial catch rates in April. Total international catch and fishing effort. Annual natural mortality estimated from multispecies assessment (ICES, 2018a). Constant maturity-at-age from surveys. 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.

History of the advice, catch, and management

Table 7 Sandeel in divisions 4.b–c, Sandeel Area 1r. History of ICES advice, the agreed TAC, and ICES estimates of catch. All weights are in tonnes. Values of catches for the period 2005 to 2015 are presented to the nearest thousand tonnes.

Year	ICES advice	Catch corresponding to advice	TAC	ICES catch SA 1	ICES catch SA 1r	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**	104000		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**	238000		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**	109000		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**	239000		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**	309000		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**	301000		414000

Year	ICES advice	Catch corresponding to advice	TAC	ICES catch SA 1	ICES catch SA 1r	Total ICES catch (SAs 1r–7r)
2011	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	< 320000	320000	312000		438000
2012	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	< 23000	23000	46000		102000
2013	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	< 224544	225000	210000		278000
2014	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	< 57000	57000	99000		264000
2015	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	< 133000	133000	163000		312000
2016	Catches for monitoring purposes should not exceed 5 000 t.	≤ 5000	13000	12751	15264	75405
2017 [^]	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	≤ 255956	255956		242069	517499
2018 [^]	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	≤ 134461	134461		132828***	270858***
2019 [^]	MSY approach: allow for sufficient stock (MSY $B_{\text{escapement}}$) to remain for successful recruitment.	≤ 91916				

* Advice for Subarea 4, excluding the Shetland area.

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

*** Preliminary.

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

History of catch and landings

Table 8 Sandeel in divisions 4.b–c, Sandeel Area 1r. Catch distribution by fleet in 2018 as estimated by ICES (in tonnes).

Total catch (2018)	Landings	Discards
132828	100% industrial trawl fisheries	negligible
	132828	

Table 9 Sandeel in divisions 4.b–c, Sandeel Area 1r. History of the total catch (in tonnes) as estimated by ICES.

Year	Catch
1983	382629
1984	498671
1985	460057
1986	382844
1987	373021
1988	422805
1989	446129
1990	306302
1991	332204
1992	558602
1993	144389
1994	193241
1995	400759
1996	291709
1997	426414
1998	377473
1999	424279
2000	374703
2001	508016
2002	610123
2003	178488
2004	215351
2005	126261
2006	247504
2007	110389
2008	236066
2009	309591
2010	300892
2011	319656
2012	46116
2013	214981
2014	98732
2015	164770
2016	15264
2017	242069
2018	132828

Summary of the assessment

Table 10 Sandeel in divisions 4.b-4.c, Sandeel Area 1r. 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. High and Low refer to 90% confidence intervals.

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Total catch	F ages 1–2	High	Low
	thousands			tonnes			tonnes			
1983	307812072	422901844	224043175	476870	681913	333482	378795	0.58	0.72	0.47
1984	76133581	105293641	55049119	205048	287842	146069	498626	0.66	0.81	0.53
1985	518784950	704851374	381836276	462314	629627	339462	437114	0.70	0.87	0.57
1986	77516393	107458571	55917282	277340	360156	213567	382844	0.47	0.58	0.38
1987	46875232	66131233	33226167	991526	1333672	737155	373021	0.37	0.46	0.30
1988	205098313	280798194	149806228	593623	800714	440093	413646	0.51	0.63	0.42
1989	93455879	128790025	67815821	160332	202256	127097	446028	0.81	0.93	0.71
1990	132222941	180602834	96803055	250196	325035	192589	306240	0.81	0.93	0.70
1991	161659043	220798602	118359654	331042	428630	255672	332204	0.57	0.67	0.50
1992	36288085	50283535	26187998	286359	367537	223110	558599	0.84	0.96	0.73
1993	149678467	204394834	109609637	262761	345692	199725	132024	0.37	0.43	0.32
1994	215183132	293068134	157996639	180232	232386	139783	193241	0.30	0.34	0.26
1995	54953614	75881569	39797538	399512	512845	311225	400588	0.56	0.65	0.49
1996	387412277	522642141	287172160	364397	466132	284866	265869	0.52	0.60	0.45
1997	60490688	83311881	43920787	233748	292282	186937	426089	0.52	0.60	0.44
1998	113919202	157093531	82610560	522301	685004	398244	377073	0.63	0.73	0.55
1999	150729892	206349316	110102136	225258	293872	172664	422718	0.93	1.08	0.80
2000	244322590	337356732	176944825	142629	177850	114383	299167	0.75	0.87	0.65
2001	405649482	552191646	297997088	160653	202735	127306	531265	1.21	1.43	1.03
2002	25520689	35453694	18370598	154972	198833	120787	606466	0.83	0.96	0.72
2003	151031654	206344496	110546008	243531	321851	184270	148039	0.72	0.83	0.62
2004	67795068	91331773	50323902	94278	123846	71769	203646	0.73	0.84	0.63
2005	149528864	199495803	112076950	117243	152786	89967	123422	0.99	1.17	0.85
2006	74626035	97131794	57334935	75584	93631	61016	240646	1.22	1.43	1.03
2007	206126373	269315935	157762970	88345	115699	67457	109624	0.44	0.52	0.37
2008	66121201	91452419	47806426	129314	158457	105531	234447	0.83	0.98	0.71
2009	479857623	619385945	371760678	155127	196471	122483	290995	1.04	1.23	0.89
2010	31327285	41560526	23613724	119731	147916	96916	300508	0.55	0.66	0.46
2011	40873807	54169308	30841599	452707	588963	347973	318840	0.61	0.73	0.51
2012	91513769	118979374	70388418	163081	221560	120037	46117	0.113	0.135	0.095
2013	51289674	67629742	38897541	97246	123308	76693	214359	0.71	0.85	0.60
2014	189519030	250811025	143205279	73644	94535	57370	78830	0.43	0.51	0.36
2015	28947662	39088105	21437907	93153	116881	74242	163381	0.40	0.48	0.34
2016	233805469	315676985	173167510	270493	353519	206966	14613	0.028	0.033	0.023
2017	20790361	30920809	13978906	183689	231204	145939	241916	0.54	0.65	0.46
2018	110773707	204456019	60016889	231886	309175	173918	130460	0.63	0.76	0.53
2019	**107870300			*97636	137280	69440				

* Using mean weight-at-age from 2014 to 2018.

** Geometric mean (1983–2017).

Sources and references

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