ICES Advice on fishing opportunities, catch and effort
Greater North Sea Ecoregion
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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 2018 should be no more than 134 461 tonnes.

Stock development over time

The spawning-stock biomass (SSB) has been above the precautionary reference points (B_{pa} = MSY $B_{escapement}$) since 2016. Recruitment (R) in 2017 was the lowest in the time-series, following an above-average recruitment in 2016. Fishing mortality (F) has fluctuated, showing a declining trend since the mid-2000s followed by an increase in 2017 to slightly below the long-term average.
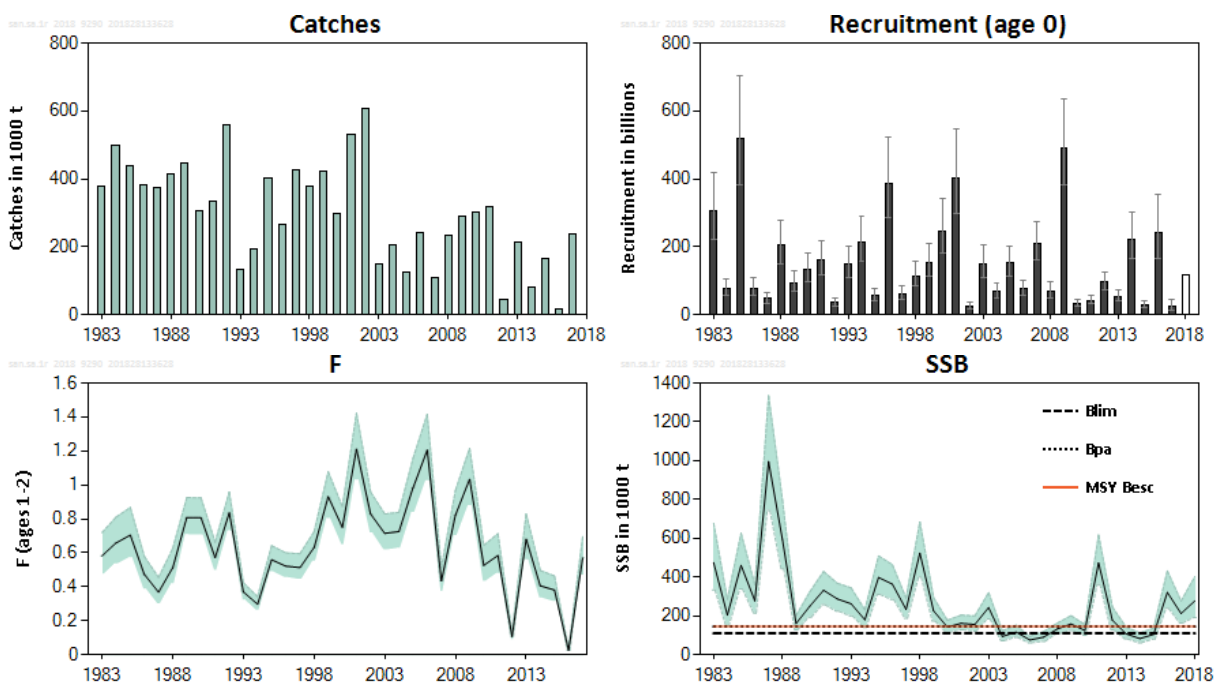

Figure 1 Sandeel in divisions 4.b–c, Sandeel Area 1r. Historical development of the stock from the summary of the stock assessment, with 90% confidence intervals. Predicted values are not shaded.

Stock and exploitation status

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			
		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.b–c, Sandeel Area 1r. The basis for the catch scenarios.

Variable	Value	Notes
F (2017)	0.57	Sum of half-yearly Fs
Recruitment (2017)	22 976 902	In thousands
Recruitment (2018)	114 975 704	Geometric mean 1983–2016 (in thousands)
SSB (2018)	277 618	In tonnes

Table 3   Sandeel in divisions 4.b–c, Sandeel Area 1r. 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						
$SSB_{2019} \geq MSY\ B_{escapement}$	134 461	0.40	145 000	−48%	−47%	−47%
Other scenarios						
F = 0	0	0	242 441	−13%	−100%	−100%
$SSB_{2019} = MSY\ B_{escapement} = B_{pa}$	134 461	0.40	145 000	−48%	−47%	−47%
B_{lim}	184 669	0.62	110 000	−60%	−28%	−28%
$F = F_{2017}$	175 140	0.57	116 558	−58%	−32%	−32%

* SSB 2019 relative to SSB 2018.
** Catch scenario for 2018 relative to TAC in 2017.
*** Advice value 2018 relative to advice value 2017.

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 for a short-living species. Recruitment in 2017 is estimated to be very low and this has contributed to the reduction in advised catch for 2018.

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 uncertainty in the estimate of the SSB, F, and recruitment are low. Figure 2 reflects the changes in the stock assessment agreed at the benchmark in 2016, as well as the updated natural mortality in 2018.

The area covered by the dredge survey in 2017 has been expanded (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

Recruitment in 2017 is very low and the survivors of the large 2016 year class are predicted to provide the basis for the fishery in 2018.

The reported catches from this area in 2014 and 2015 were revised in 2017, based on information from VMS and previous catch distributions, to account for substantial area misreporting of catches. 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 eliminated the misreporting issue for Danish catches; however, there are strong indications of area misreporting for other nations in 2015. Management measures for all nations, similar to those in the Danish fishery, would further reduce area misreporting.
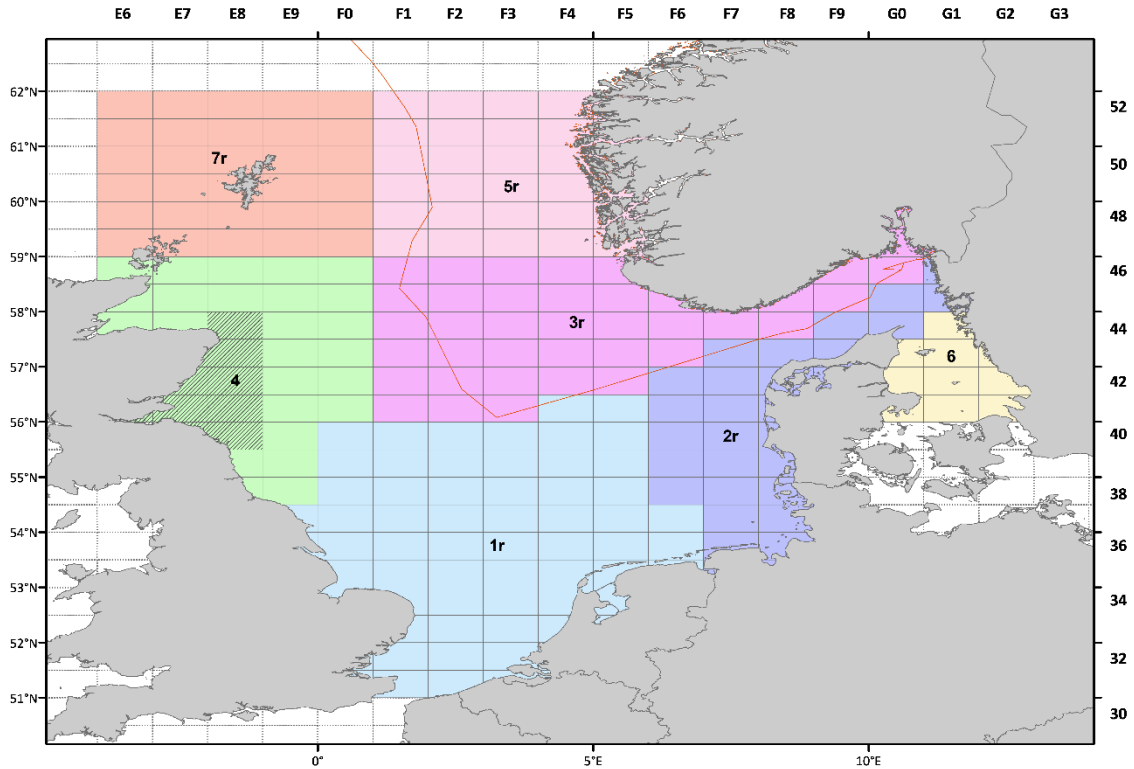
Figure 3   Sandeel in divisions 4.b–c, Sandeel Area 1r. Stock areas for the seven sandeel stocks. The Norweigan Exclusive Economic Zone (EEZ) is shown as a red line. The closed area in sandeel area 4 is shown with hatched markings.

Reference points

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

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{escapement}$	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_{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	$B_{pa} = B_{lim} \times \exp(\sigma \times 1.645)$, 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, 2016).
Assessment type	Age-structured model (SMS-effort), seasonal (ICES, 2018a).
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, 2018b). 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

The unusually low lipid contenet of sandeel observed by the industry in April 2017 is consistent with the lower weight-at-age in the assessment.

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
2011	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 320000	320000	312000		438000
2012	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 23000	23000	46000		102000
2013	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 224544	225000	210000		278000

Year	ICES advice	Catch corresponding to advice	TAC	ICES catch SA 1	ICES catch SA 1r	Total ICES catch (SAs 1r–7r)
2014	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	< 57000	57000	99000		264000
2015	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) 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 $B_{escapement}$) to remain for successful recruitment.	≤ 255956	255956		235726***	518410***
2018^	MSY approach: allow for sufficient stock (MSY $B_{escapement}$) to remain for successful recruitment.	≤ 134461				

* 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 in 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 2017 as estimated by ICES (in tonnes).

Total catch (2017)	Landings	Discards
235 726	100% industrial trawl fisheries	Negligible
	235 726	

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	235726

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.

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Catches	F ages 1–2	High	Low
	thousands			tonnes			tonnes	per year		
1983	305664912	419413371	222765998	475442	677425	333683	378795	0.583	0.719	0.473
1984	76515202	105588421	55447142	204638	285477	146691	498626	0.659	0.811	0.535
1985	520343641	705099201	383999166	460469	625836	338797	437114	0.704	0.867	0.571
1986	77593949	107332767	56094900	277618	358824	214789	382844	0.472	0.578	0.385
1987	47157329	66359796	33511461	995500	1334927	742378	373021	0.369	0.455	0.299
1988	204279559	279162440	149483355	595407	799298	443526	413646	0.511	0.625	0.417
1989	94206525	129559930	68500108	160974	202417	128017	446028	0.808	0.925	0.706
1990	132222941	180279293	96976784	250446	324590	193239	306240	0.807	0.924	0.704
1991	160691992	219084593	117862767	332369	428758	257649	332204	0.573	0.663	0.495
1992	36215581	50079985	26189471	287506	368059	224583	558599	0.835	0.958	0.728
1993	148783085	202708102	109203363	262761	344631	200340	132024	0.369	0.424	0.322
1994	214538550	291556471	157865779	180052	231330	140140	193241	0.298	0.342	0.26
1995	55450429	76424132	40232711	397918	509421	310820	400588	0.559	0.642	0.487
1996	387025059	521030108	287485106	363669	463864	285117	265869	0.522	0.6	0.454
1997	60854724	83667236	44262217	233982	291484	187824	426089	0.513	0.595	0.443
1998	114147268	157100199	82938144	523347	684492	400139	377073	0.631	0.724	0.55
1999	152092584	207766631	111337196	225934	293564	173885	422718	0.93	1.077	0.802
2000	247024974	340314712	179308551	143057	177830	115084	299167	0.751	0.871	0.647
2001	403626297	548317974	297116263	161943	203859	128645	531265	1.21	1.422	1.029
2002	25393404	35205562	18315996	156061	199742	121932	606466	0.828	0.958	0.716
2003	150729892	205333487	110646835	243045	320232	184462	148039	0.715	0.829	0.616
2004	67727306	91348616	50214094	94089	123109	71910	203646	0.725	0.838	0.626
2005	151334019	201867642	113450502	117008	151988	90079	123422	0.983	1.156	0.837
2006	76438725	99759927	58569397	76267	94448	61587	240646	1.204	1.416	1.024
2007	208406280	272205193	159560429	90581	118661	69146	109624	0.435	0.511	0.371
2008	69164619	95424453	50131222	132720	163237	107909	234447	0.824	0.968	0.701
2009	492005277	634585400	381460387	158895	201486	125308	290995	1.033	1.216	0.878
2010	32736460	43723921	24510057	124742	155053	100356	300508	0.527	0.644	0.431
2011	41992433	55915165	31536426	472598	616664	362189	318840	0.584	0.713	0.478
2012	94963199	124166750	72628213	177549	246211	128035	46117	0.108	0.132	0.089
2013	54406816	72689101	40722771	107904	142356	81790	214359	0.68	0.829	0.558
2014	223294034	300395661	165981844	83200	112114	61742	78830	0.406	0.496	0.333
2015	29473438	40804378	21288979	104611	136869	79955	163381	0.381	0.464	0.313
2016	242861043	354821192	166228759	321258	432172	238810	14613	0.027	0.033	0.022
2017	22976902	44121544	11965538	212352	276648	162999	235593	0.57	0.696	0.467
2018	114975704**			277618*	402762	191358				
Average	**153814282**	**210377524**	**114222627**	**263431**	**347218**	**200136**	**300134**	**0.632**	**0.746**	**0.536**

* Using mean weight-at-age from 2013 to 2017.
** Geometric mean (1983–2016).

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