

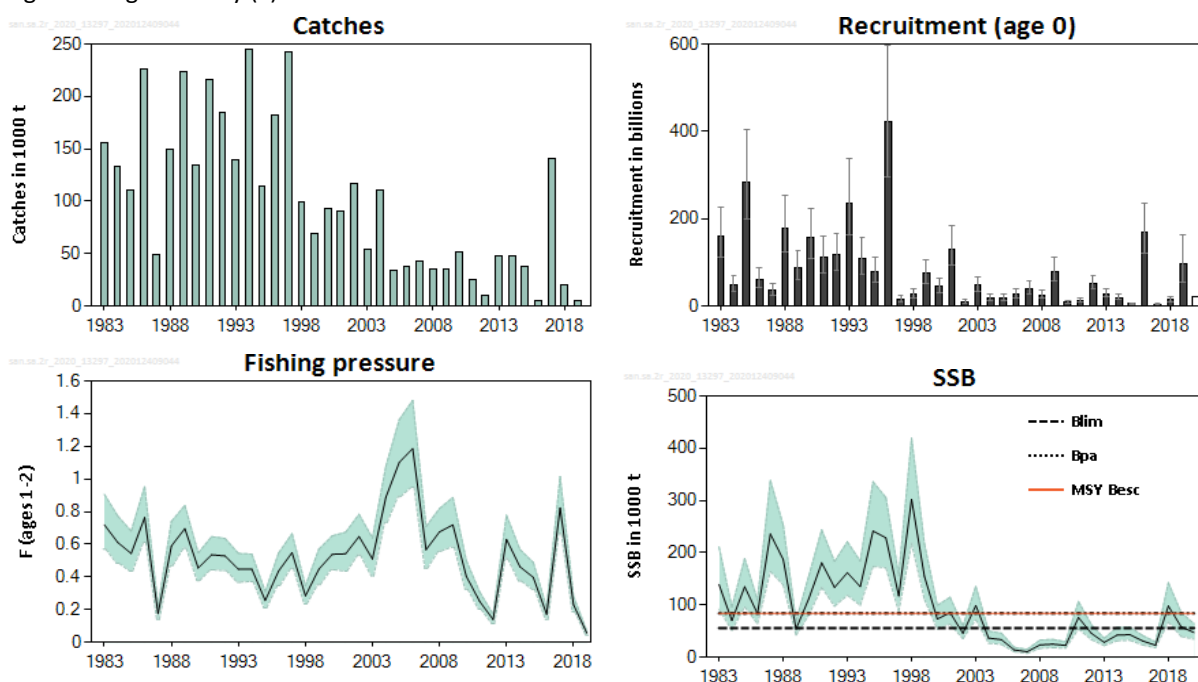
## Sandeel (*Ammodytes* spp.) in divisions 4.b–c and Subdivision 20, Sandeel Area 2r (central and southern North Sea)

### ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2020 should be no more than 62 658 tonnes.

### Stock development over time

Following the 2016 recruitment, which was the highest recruitment observed since 1996, the spawning-stock biomass (SSB) first increased to above  $B_{pa}$  in 2018, and then decreased again to below  $B_{lim}$  in 2020. Recruitment has been low since 2000, with the exception of the 2016 year class. The 2019 year class is estimated to be slightly above the long-term average. Fishing mortality (F) was low in 2019.



**Figure 1** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. Historical development of the stock from the summary of the stock assessment with 90% confidence intervals. Assumed recruitment values are not shaded.

### Stock and exploitation status

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

**Table 1** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. State of the stock and fishery relative to reference points.

	Fishing pressure			Stock size			
		2017	2018	2019	2018	2019	2020
Maximum sustainable yield	$F_{MSY}$	?	?	?	Undefined	MSY	
Precautionary approach	$F_{pa}, F_{lim}$	?	?	?	Undefined	$B_{escapement}$	Below escapement
Management plan	$F_{MGT}$	—	—	—	Not applicable	$B_{pa}, B_{lim}$	Reduced reproductive capacity
						$B_{MGT}$	Not applicable

**Catch scenarios**

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

Variable	Value	Notes
F (2019)	0.056	From the assessment
Recruitment (2019)	95 725 952	From the assessment; in thousands
Recruitment (2020)	20 825 766	Geometric mean 2009–2018; in thousands
SSB (2020)	47 240	In tonnes

**Table 3** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. Annual catch scenarios. All weights are in tonnes.

Basis	Total catch (2020)	F <sub>total</sub> (2020)	SSB (2021)	% SSB change *	% TAC change **	% advice change ***
<b>ICES advice basis</b>						
SSB <sub>2021</sub> ≥ MSY B <sub>escapement</sub> with F <sub>cap</sub>	62658	0.44	91553	94%	+1153	-
<b>Other scenarios</b>						
F = 0	0	0	131351	178%	-100	-
SSB <sub>2021</sub> = MSY B <sub>escapement</sub> = B <sub>pa</sub>	74745	0.549	84000	78%	+1395	-
B <sub>lim</sub>	120528	1.083	56000	19%	+2311	-
F <sub>2020</sub> = F <sub>sq</sub>	9447	0.056	125298	165%	+89	-

\* SSB<sub>2021</sub> relative to SSB<sub>2020</sub>.

\*\* Catch scenario for 2020 relative to the monitoring TAC in 2019 (5000 t).

\*\*\* Advice value 2020 relative to advice value 2019 (0 t).

Stock size at the beginning of 2020 is estimated to be below B<sub>lim</sub> but the 2019 year class is estimated to be above the long term average and will contribute to both an increase in SSB and the catch advised for 2020.

**Basis of the advice**

**Table 4** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. The basis of the advice.

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

**Quality of the assessment**

The assessment this year is consistent with the assessment from 2018 and 2019.

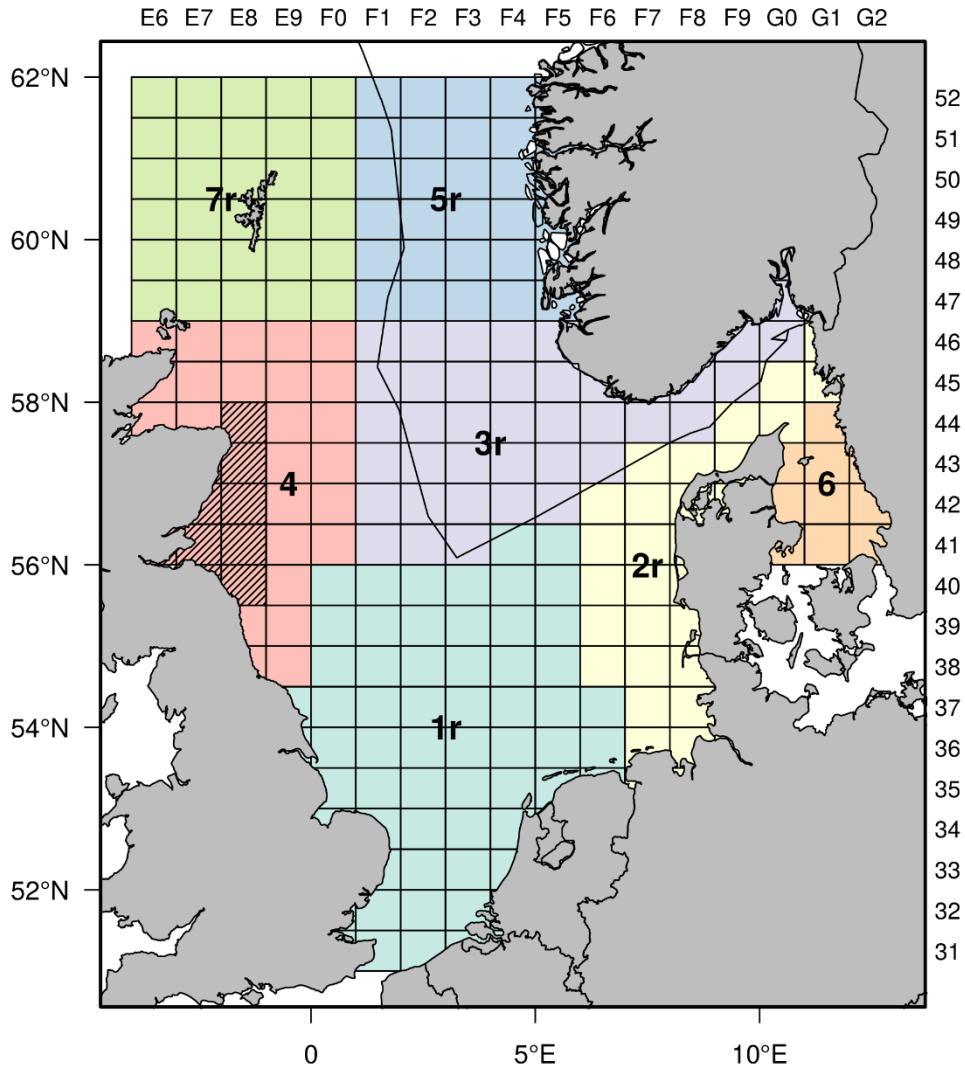
This stock was interbenchmarked in 2020, considering the tendency of the assessment to overestimate both recruitment and SSB when recruitment is above average (ICES, 2020b). A density-dependency in the dredge survey recruitment index was included in the assessment model to account for the overestimation of large incoming year classes. This change reduced the overestimation of SSB and recruitment in the assessment model.



**Figure 2** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. Historical assessment results (final-year recruitment is the geometric mean).

**Issues relevant for the advice**

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.



**Figure 3** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. 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 and Subdivision 20, Sandeel Area 2r. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{\text{escapement}}$	84 000 t	= $B_{\text{pa}}$	ICES (2017)
	$F_{\text{MSY}}$	Not defined		
	$F_{\text{cap}}^*$	0.44	Maximum $F$ , estimated from the management strategy evaluation (MSE), resulting in less than 5% probability of $SSB < B_{\text{lim}}$ .	ICES (2017)
Precautionary approach	$B_{\text{lim}}$	56 000 t	Average SSB of the two lowest SSB estimates (in 2001 and 2009) that provide high recruitment.	ICES (2017)
	$B_{\text{pa}}$	84 000 t	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$ , with $\sigma = 0.25$ estimated from the assessment uncertainty in the terminal year.	ICES (2017)
	$F_{\text{lim}}$	Not defined		
Management plan	$SSB_{\text{MGT}}$	Not defined		
	$F_{\text{MGT}}$	Not defined		

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

## Basis of the assessment

**Table 6** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. The basis of the assessment and advice.

ICES stock data category	1 (see <a href="#">ICES, 2019</a> ).
Assessment type	Analytical age-based (SMS-effort), half-yearly time-steps (ICES, 2020a).
Input data	One survey index (dredge survey since 2010). Total international catch and fishing effort. Constant maturity-at-age from surveys. Natural mortality estimated from multispecies assessment (assumed constant over time; ICES, 2018). Age frequencies from catch sampling.
Discards and bycatch	Discarding is considered to be negligible.
Indicators	None.
Other information	Last benchmarked in 2016 ( <a href="#">ICES, 2017</a> ). Interbenchmarked in 2020 (ICES, 2020b).
Working group	Herring Assessment Working Group ( <a href="#">HAWG</a> )

## Information from stakeholders

There is no additional available information.

## History of advice, catch, and management

**Table 7** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. 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 2	ICES catch SA 2r	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**	41000		177000
2006*	The fishery should remain closed until information is available which assures that the stock can be rebuilt to $B_{\text{pa}}$ by 2007.	-	300000**	35000		293000
2007*	The fishery should remain closed until information is available which assures that the stock can be rebuilt to $B_{\text{pa}}$ by 2008.	-	173000**	6000		230000
2008*	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to $B_{\text{pa}}$ by 2009.	-	375000**	13000		348000
2009*	The fishery should only be allowed if monitoring information is available and shows that the stock can be rebuilt to $B_{\text{pa}}$ by 2010.	-	377000**	10000		353000

Year	ICES advice	Catch corresponding to advice	TAC	ICES catch SA 2	ICES catch SA 2r	Total ICES catch (SAs 1r–7r)
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**	32000		414000
2011	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	< 34000	34000	30000		438000
2012	Catches for monitoring purposes should not exceed 5000 t.	< 5000	5000	8000		102000
2013	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	< 17544	18000	23000		278000
2014	Catches for monitoring purposes should not exceed 5000 t.	< 5000	5000	8900		264000
2015	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	< 29000	29000	21000		312000
2016	Catches for monitoring purposes should not exceed 5000 t.	≤ 5000	5000	4037	9569	75405
2017 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	≤ 175941	175941		141314	517499
2018 <sup>^</sup>	Catches for monitoring purposes should not exceed 5000 t.	≤ 5000	5000		20240	269579
2019 <sup>^</sup>	Catches for monitoring purposes should not exceed 5000 t.	≤ 5000	5000		5274***	234778***
2020 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	≤ 62658				

\* Advice for Subarea 4, excluding the Shetland area.

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

\*\*\* Preliminary.

<sup>^</sup> ICES statistical rectangles included in this sandeel area changed with the 2017 assessment and advice.

### History of catch and landings

**Table 8** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. Catch distribution by fleet in 2019 data as estimated by ICES (in tonnes).

Total catch (2019)	Landings	Discards
5274	100% industrial trawl fisheries	Discarding is considered negligible
	5274	

**Table 9** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. History of total catch (in tonnes) as estimated by ICES.

Year	Catch
1982	138899
1983	156208
1984	133398
1985	111889
1986	225581
1987	49067
1988	151543
1989	227292
1990	133796
1991	215565
1992	184241
1993	147964

Year	Catch
1994	244944
1995	122155
1996	186460
1997	242680
1998	100425
1999	63165
2000	100336
2001	84682
2002	117557
2003	44504
2004	116767
2005	34568
2006	37768
2007	43402
2008	35120
2009	36709
2010	51635
2011	24897
2012	12552
2013	47847
2014	65084
2015	37899
2016	9569
2017	141314
2018	20240
2019	5274

### Summary of the assessment

**Table 10** Sandeel in divisions 4.b–c and Subdivision 20, Sandeel Area 2r. Assessment summary. Weights are in tonnes, recruitment is 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. High and low represent 90% confidence intervals.

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Total catch tonnes	F (ages 1–2)	High	Low
	thousands				tonnes				High	Low
1983	159571076	227609124	111871299	139525	211318	92123	155664	0.72	0.91	0.57
1984	47346336	68161148	32887879	70404	95883	51695	133343	0.61	0.77	0.48
1985	282729170	403246300	198230668	134996	188960	96443	110546	0.54	0.68	0.44
1986	61527821	88937857	42565369	83700	109422	64025	225470	0.76	0.95	0.61
1987	36107097	51943206	25098999	235861	338410	164388	49070	0.176	0.22	0.140
1988	177592117	253068256	124626298	187213	252993	138535	149466	0.59	0.74	0.47
1989	87137684	125797219	60358854	54176	69436	42270	223507	0.70	0.84	0.58
1990	156098847	222883607	109325447	112308	155771	80972	133874	0.46	0.55	0.38
1991	110995476	160036927	76982206	180593	243751	133800	215508	0.54	0.65	0.44
1992	116569708	167516469	81117378	133786	183310	97642	184033	0.53	0.64	0.44
1993	235212519	338936366	163231021	161943	220994	118671	139826	0.45	0.54	0.37
1994	107607403	156884266	73808250	135266	184041	99418	244939	0.45	0.54	0.37
1995	77671581	112317838	53712524	241591	335836	173793	113899	0.26	0.31	0.21
1996	421360787	598062207	296866966	228662	305650	171066	182562	0.44	0.55	0.35
1997	15744474	23093370	10734183	117360	156379	88077	242094	0.55	0.67	0.45
1998	26856005	38873129	18553819	302247	419058	217997	99814	0.28	0.35	0.24
1999	75376039	107281732	52959131	155127	216870	110962	69427	0.45	0.57	0.35
2000	44057229	63175102	30724753	73204	99392	53916	92908	0.54	0.65	0.45

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Total catch	F (ages 1–2)	High	Low
	thousands			tonnes			tonnes			
2001	130907300	184731672	92765475	85477	114817	63634	90200	0.54	0.67	0.44
2002	10303560	14863834	7142393	46074	59704	35555	117388	0.65	0.78	0.54
2003	47346336	67373013	33272604	99012	135789	72196	53710	0.51	0.64	0.41
2004	19000959	27684793	13040966	36717	50221	26844	110546	0.89	1.08	0.73
2005	19115307	28032962	13034476	33759	46132	24705	34396	1.10	1.36	0.89
2006	26775558	38789851	18482424	14167	19093	10512	37860	1.19	1.48	0.95
2007	39192658	56526928	27174030	10735	15308	7529	43090	0.57	0.71	0.45
2008	24915484	36294616	17103951	23766	32967	17132	35604	0.68	0.82	0.56
2009	79240651	111878594	56124059	25084	34214	18391	35687	0.72	0.89	0.58
2010	9771690	13326712	7165002	22743	29829	17340	51670	0.40	0.50	0.33
2011	12839026	17430365	9457093	76191	106673	54420	24896	0.25	0.31	0.20
2012	52430550	70102931	39213234	45982	62570	33791	10594	0.140	0.172	0.114
2013	28688302	38361212	21454449	28538	36509	22308	47814	0.63	0.78	0.51
2014	19501462	26353677	14430891	42447	57056	31578	48033	0.46	0.57	0.38
2015	5288261	7254057	3855181	43391	57670	32647	37902	0.40	0.49	0.33
2016	168593323	236313621	120279603	31351	41683	23580	5230	0.172	0.21	0.140
2017	3867040	5682294	2631684	23133	29417	18191	141314	0.82	1.01	0.67
2018	15263883	22392141	10404817	98125	142625	67510	20239	0.23	0.28	0.187
2019	95725952	164175547	55814998	58454	85537	39946	5216	0.056	0.068	0.045
2020	20825766*			47240**	64404	34650				

\* Geometric mean (2009–2018).

\*\* Using mean weight-at-age from 2015 to 2019.

## Sources and references

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