

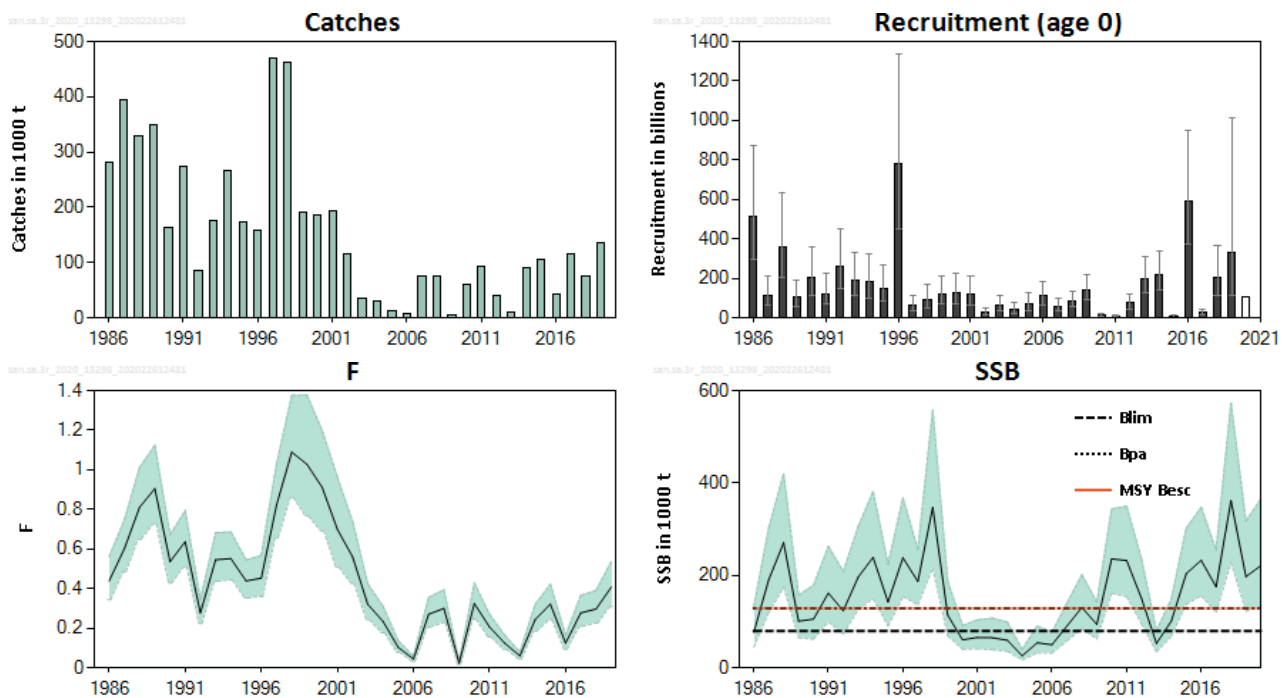
## Sandeel (*Ammodytes* spp.) in divisions 4.a–b and Subdivision 20, Sandeel Area 3r (northern and central North Sea, Skagerrak)

### ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2020 should be no more than 155 072 tonnes.

### Stock development over time

The spawning-stock biomass (SSB) has been above  $B_{pa} = MSY B_{escapement}$  since 2015. The recruitment (R) in 2019 is the fifth highest on record, and the recruitment in 2018 was also above the long-term average. Fishing mortality (F) declined in the early 2000s and has been low since then. F has increased in the last three years; however, it is still below the long-term average.



**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. Assumed recruitment values are not shaded.

### Stock and exploitation status

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

**Table 1** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. 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	$MSY B_{escapement}$	✓ ✓ ✓ Above escapement
Precautionary approach	$F_{pa}, F_{lim}$	?	?	?	Undefined	$B_{pa}, B_{lim}$	✓ ✓ ✓ Full reproductive capacity
Management plan	$F_{MGT}$	—	—	—	Not applicable	$B_{MGT}$	— — — 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 (2019)	0.41	From the assessment
Recruitment (2019)	334 116 402	From the assessment; in thousands
Recruitment (2020)	102 992 005	Geometric mean 1986–2018; in thousands
SSB (2020)	221 239	In tonnes

**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 (2020)	F <sub>total</sub> (2020)	SSB (2021)	% SSB change *	% TAC change **	% advice change ***
ICES advice basis						
SSB <sub>2021</sub> ≥ MSY B <sub>escapement</sub> with F <sub>cap</sub>	155072	0.29	298955	+35	+14	+16
Other scenarios						
F = 0	0	0	385956	+74	-100	-100
SSB <sub>2021</sub> ≥ MSY B <sub>escapement</sub>	482681	1.292	129000	-42	+256	+261
B <sub>lim</sub>	590865	1.91	80000	-64	+335	+342
F <sub>2019</sub>	208340	0.41	269841	+22	+54	+56

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

\*\* Catch scenario for 2020 relative to the TAC in 2019 (135 689 t – the sum of the Norwegian and EU TAC, 125 000 t and 10 689 t, respectively).

\*\*\* Advice value 2020 relative to the advice value 2019 (133 610 t).

Recruitment in 2019 is high and, together with the high abundance of ages 2 and 4, contributes to the increase in catch advice for 2020.

**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 <sub>cap</sub> )
Management plan	ICES is not aware of any agreed precautionary management plan for sandeel in this area.

**Quality of the assessment**

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

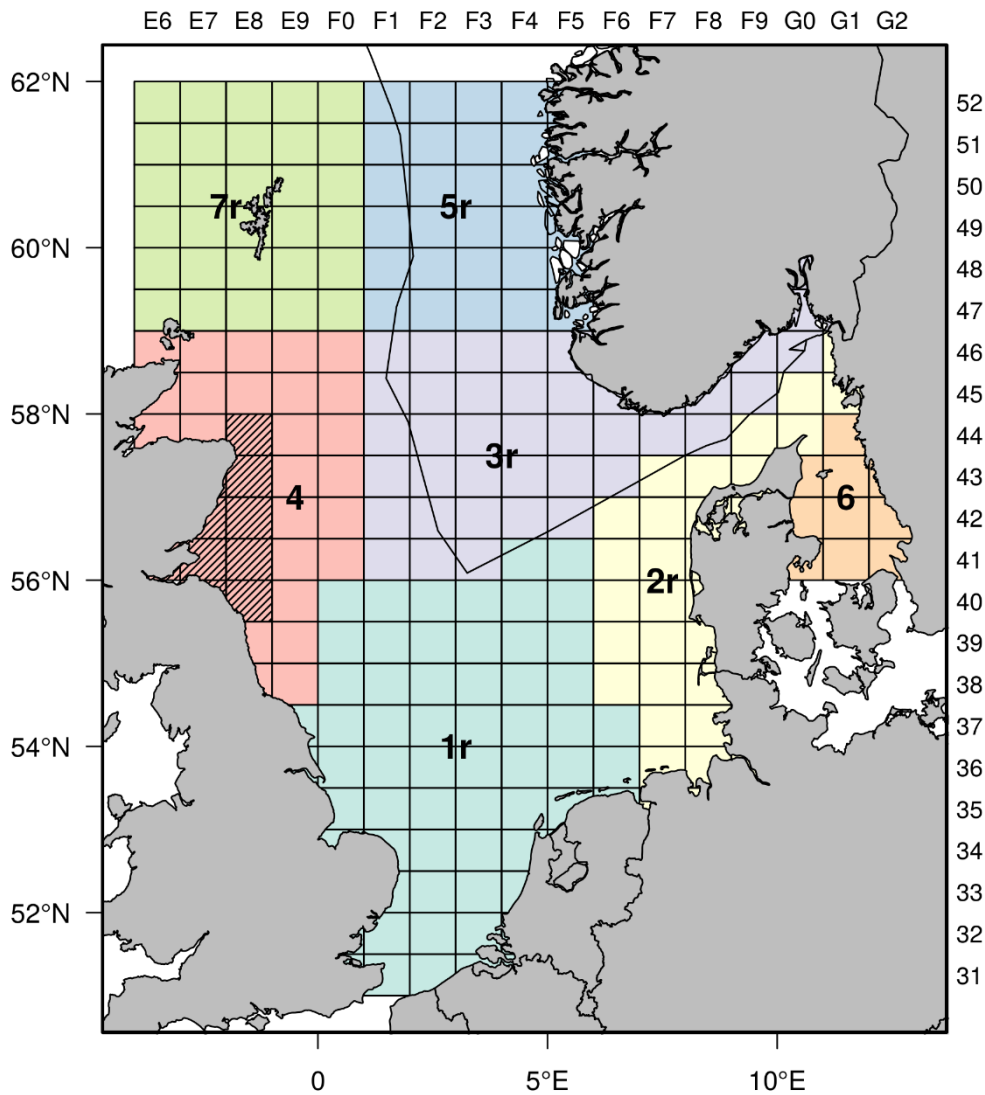


**Figure 2** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Historical assessment results (final-year recruitment is the geometric mean).

**Issues relevant for the advice**

ICES provides catch advice for this stock according to the MSY approach; however, most of this area is within the Norwegian Exclusive Economic Zone (EEZ), where fisheries are managed by areas that are alternately open and closed (ICES, 2019). ICES has not evaluated this management measure.

The updated assessment from the interbenchmark in 2020 reduces the bias previously observed in estimates of incoming large year classes; these estimates are significant for the forecasted biomass (ICES, 2020a).



**Figure 3** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. 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.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	= $B_{\text{pa}}$	ICES (2017)
	$F_{\text{MSY}}$	Not defined		
	$F_{\text{cap}}^*$	0.29	The maximum F, as estimated from the management strategy evaluation (MSE), that results in less than 5% probability of $SSB < B_{\text{lim}}$ .	ICES (2017)
Precautionary approach	$B_{\text{lim}}$	80 000 t	The lowest SSB at which a high recruitment is observed.	ICES (2017)
	$B_{\text{pa}}$	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)
	$F_{\text{lim}}$	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.a–b and Subdivision 20, Sandeel Area 3r. The basis of the assessment and advice.

ICES stock data category	1 (see <a href="#">ICES, 2019</a> ).
Assessment type	Age-structured model (SMS-effort), half-yearly time-step (ICES, 2020b).
Input data	Acoustic survey index (2009–2019) and dredge survey index (2005–2019). Total international catch and fishing effort. Constant maturity-at-age estimated from the dredge survey. Natural mortality estimated from multispecies assessment (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> ). Interbenchmarking in 2020 ( <a href="#">ICES, 2020a</a> ).
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.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 $B_{\text{pa}}$ 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 $B_{\text{pa}}$ 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 $B_{\text{pa}}$ by 2009.	-	375000**	128000	95000		348000

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)
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.	$\leq 123135$	63000	40000	50737	44076	75405
2017 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	$\leq 74176$	0	120000		115642	517498
2018 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	$\leq 108365$	8669	70000		74933	270858
2019 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	$\leq 133610$	10689	125000		135590 <sup>^^</sup>	234778 <sup>^^</sup>
2020 <sup>^</sup>	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	$\leq 155072$					

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

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

\*\*\* TAC for EU fisheries set at 10 000 t; seasonal effort limitations set for Norwegian fisheries.

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

<sup>^^</sup> 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 2019 as estimated by ICES (in tonnes).

Total catch (2019)	Landings	Discards
135590	100% industrial trawl fisheries	Discarding is considered negligible
	135590	

**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
2009	6362
2010	61243
2011	92452
2012	40134
2013	9844
2014	95464
2015	104631
2016	44076
2017	115642
2018	74933
2019	135590

## 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. High and Low refer to 90% confidence intervals.

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Total catch	Fishing pressure (ages 1–2)	High	Low
	thousands			tonnes			tonnes			
1986	511572565	874840037	299147819	77188	132775	44873	282315	0.44	0.56	0.34
1987	116803080	209211975	65211179	190804	303032	120139	395296	0.60	0.75	0.49
1988	359778816	629954057	205476566	271034	419961	174920	330358	0.81	1.01	0.65
1989	107070708	190040012	60324857	101215	157230	65156	350409	0.91	1.12	0.73
1990	202651842	358228652	114641218	105451	178834	62180	163224	0.54	0.67	0.43
1991	123407198	223729732	68070240	161781	263093	99482	274839	0.64	0.80	0.51
1992	261776070	453779934	151013091	123500	208194	73260	86788	0.28	0.35	0.22
1993	191806959	334399697	110017771	196614	306232	126235	175786	0.55	0.68	0.44
1994	181905886	324222305	102058837	239187	381627	149912	267281	0.55	0.69	0.44
1995	148783085	266545610	83049225	142629	224230	90724	173607	0.44	0.55	0.35
1996	777815572	1334415726	453379747	238232	367765	154323	159024	0.45	0.57	0.36
1997	63148522	112418504	35472237	187025	256135	136563	470670	0.82	1.03	0.66
1998	94112365	166691614	53134870	347319	557739	216285	462081	1.09	1.38	0.86
1999	120601225	211183863	68872002	114348	187884	69593	191253	1.03	1.38	0.77
2000	126531266	227372271	70413869	60779	91542	40354	186837	0.91	1.20	0.69
2001	118095007	210543568	66240117	65907	104048	41748	193684	0.70	0.96	0.51
2002	28431266	52813583	15305473	65121	107499	39449	116298	0.56	0.74	0.43
2003	63148522	114937302	34694879	59695	99181	35929	34673	0.32	0.42	0.24
2004	40345886	75932608	21437306	26291	40277	17162	31285	0.24	0.31	0.178
2005	70280153	125110288	39479566	54339	90562	32605	13991	0.104	0.137	0.079
2006	111328962	186076712	66607678	50111	77617	32353	7094	0.045	0.059	0.034
2007	59115280	96283747	36294977	90762	140445	58655	74972	0.27	0.36	0.21
2008	87224865	137801958	55210951	130744	201383	84884	74933	0.30	0.40	0.23
2009	140680230	219041073	90352585	94278	142193	62509	6261	0.025	0.033	0.0190
2010	13783737	22834579	8320338	235861	344006	161714	61241	0.33	0.43	0.25
2011	10574965	17526896	6380473	232350	349856	154311	92452	0.21	0.27	0.157
2012	74925137	122575185	45798635	150242	235395	95892	40116	0.125	0.165	0.095
2013	195681716	306751105	124828675	52892	80425	34784	9844	0.061	0.080	0.046
2014	217998775	335739789	141548507	101316	148991	68897	90876	0.24	0.32	0.186
2015	6695860	11584919	3870078	204230	302532	137869	104631	0.32	0.42	0.24
2016	593174986	947090784	371513027	232815	347428	156012	42845	0.125	0.165	0.095
2017	26429728	43839825	15933698	175255	255036	120432	115642	0.28	0.37	0.21
2018	202246943	366782038	111520799	361855	573004	228514	75143	0.30	0.39	0.23
2019	334116402	1011663865	110346701	197402	317806	122615	135590	0.41	0.54	0.31
2020	102992005**			221239*	365248	134010				

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

\*\* Geometric mean (1986–2018).

## Sources and references

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