

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

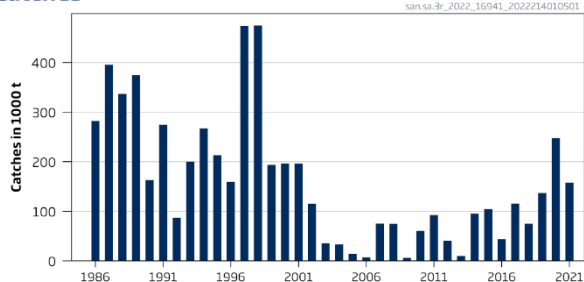
### ICES advice on fishing opportunities

ICES advises that when the MSY approach is applied, catches in 2022 should be no more than 85 559 tonnes.

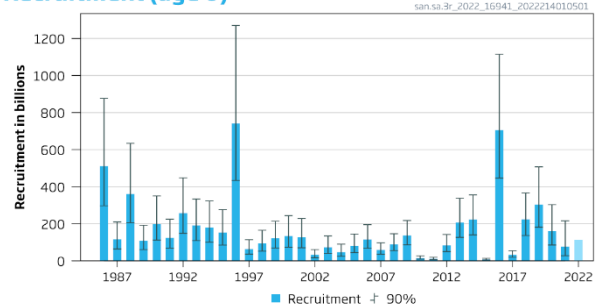
### Stock development over time

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.

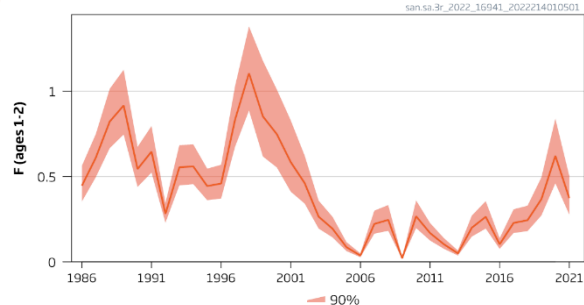
#### Catches



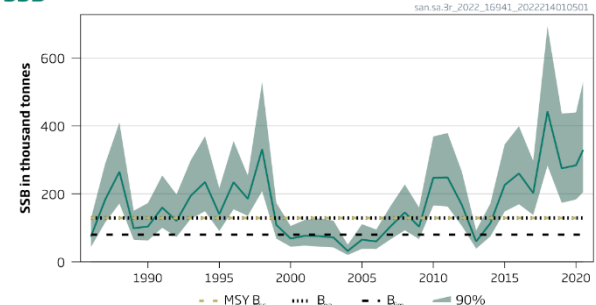
#### Recruitment (age 0)



#### F



#### SSB



**Figure 1** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Summary of the stock assessment. The assumed recruitment value for 2022 is shaded in a lighter colour.

### Catch scenarios

**Table 1** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Values in the forecast .

Variable	Value	Notes
F (2021)	0.37	Assessment model estimate
Recruitment (2021)	77206947	Assessment model estimate; thousands
Recruitment (2022)	112945768	Geometric mean 1986–2020; thousands
SSB (2022)	210029	Assessment model estimate; tonnes

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

Basis	Total catch (2022)	$F_{total}$ (2022)	SSB (2023)	% SSB change *	% TAC change **	% advice change ***
ICES advice basis						
$SSB_{2023} \geq MSY B_{escapement}$ with $F_{cap}$	85559	0.29	151563	-28	-46	-47
Other scenarios						
$F = 0$	0	0	200747	-4	-100	-100
$SSB_{2023} = B_{pa} = B_{escapement}$	126038	0.46	129000	-39	-20	-22
$SSB_{2023} = B_{lim}$	218345	0.99	80000	-62	39	35
$F_{2021}$	106151	0.37	140019	-33	-33	-34

\*  $SSB_{2023}$  relative to  $SSB_{2022}$ .

\*\* Catch scenario for 2022 relative to the TAC in 2021 (157 641 t = the sum of the Norwegian [145 000 t] and EU [12 641 t] TAC).

\*\*\* Advice value 2022 relative to advice value 2021 (161 335 t).

The large decrease in advice from 2021 is due to the lower 2021 year class.

### Basis of the advice

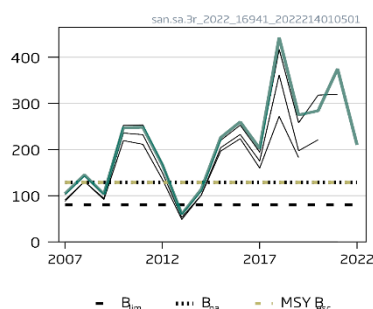
**Table 3** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. The basis of the advice.

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

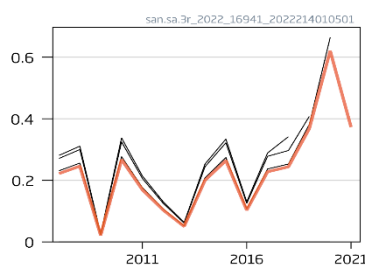
### Quality of the assessment

The 2019 and 2020 recruitment values have been revised further downwards by this year's assessment.

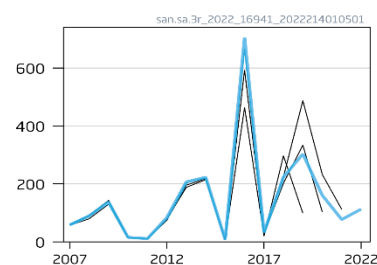
#### SSB (thousand tonnes)



#### F (ages 1-2)



#### Rec (age 0; Billions)



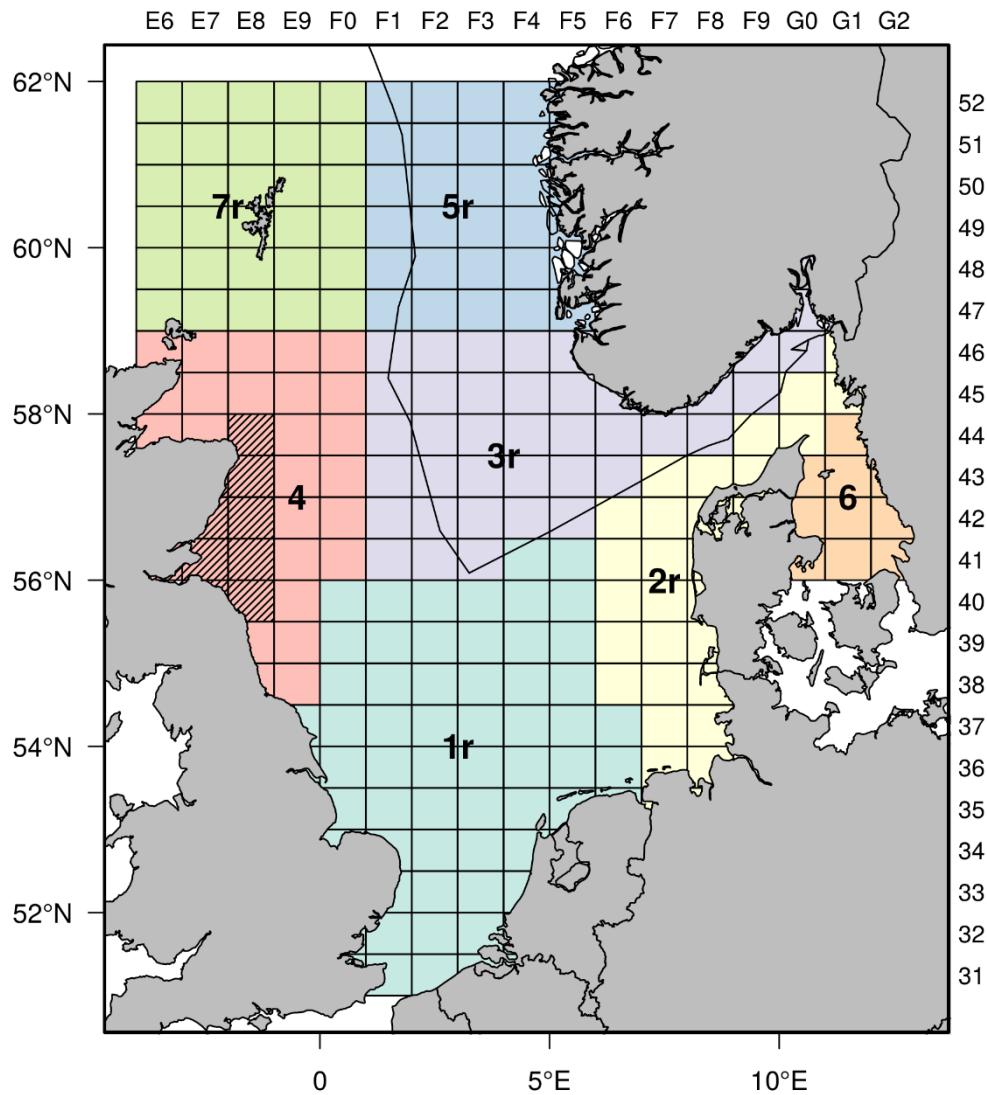
**Figure 2** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Historical assessment results (final-year recruitment is the geometric mean).

### Issues relevant for the advice

The large change in the advice from year to year is caused by the marked interannual variability of biomass and recruitment as well as the early maturation, both of which are typical for a short-lived species.

The assessment model has a density-dependent parameter which was introduced in the 2020 interbenchmark (ICES, 2020) to reduce the tendency of the model to overestimate both recruitment and SSB especially in years with incoming high year classes. This change reduced the overestimation of SSB and recruitment.

Most of Sandeel Area 3r is within the Norwegian Exclusive Economic Zone (EEZ), where fisheries are managed by areas that are alternately open and closed based on an acoustic measurement of the stock each May and the setting of minimum biomass limits. ICES has not been requested to evaluate this management approach.



**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 shown as a black line. The closed part of Sandeel Area 4 is shown with hatched markings.

### Reference points

**Table 4** 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	$B_{\text{pa}}$ ; Tonnes	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 < 5% probability of $\text{SSB} < B_{\text{lim}}$	ICES (2017)
Precautionary approach	$B_{\text{lim}}$	80 000	The lowest SSB at which a high recruitment is observed; tonnes	ICES (2017)
	$B_{\text{pa}}$	129 000	$B_{\text{pa}} = B_{\text{lim}} \times \exp(\sigma \times 1.645)$ , with $\sigma = 0.29$ estimated from the assessment uncertainty in the terminal year; tonnes	ICES (2017)
	$F_{\text{lim}}$	Not defined		
Management plan	$\text{SSB}_{\text{MGT}}$	Not defined		
	$F_{\text{MGT}}$	Not defined		

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

## Basis of the assessment

**Table 5** 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, 2021</a> )
Assessment type	Age-structured model (SMS-effort), half-yearly time-step (ICES, 2022)
Input data	Acoustic survey index (A6823; 2010–2021) and dredge survey index (D9376; 2005–2021). 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> ). Interbenchmark in 2020 ( <a href="#">ICES, 2020</a> )
Working group	Herring Assessment Working Group ( <a href="#">HAWG</a> )

## History of advice, catch, and management

**Table 6** 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 $B_{pa}$ 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	$\leq 123135$	63000	40000	50737	44074	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 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 74176	0	120000		115642	517499
2018 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 108365	8669	70000		75143	269579
2019 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 133610	10689	125000		136901	235537
2020 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 155072	12406	250000		247411	446765
2021 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 161335	12641	145000		157752 <sup>^^</sup>	233178 <sup>^^</sup>
2022 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment	≤ 85559					

\* 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 7** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Catch distribution by fleet in 2021 as estimated by ICES (in tonnes).

Total catch (2021)	Landings	Discards
157752	100% industrial trawl fisheries	Discarding is considered negligible
	157752	

## Summary of the assessment

**Table 8** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Assessment summary with weights (in tonnes) and recruitment (at age 0, in thousands). The SSB is estimated for 1 January. 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			
1986	510550442	877195005	297153714	74236	126969	43404	282334	0.45	0.56	0.35
1987	116104360	209605576	64312327	182773	288440	115816	395298	0.61	0.75	0.50
1988	360859773	634158425	205342657	265136	409945	171480	336919	0.82	1.01	0.67
1989	107715064	191848424	60477614	98913	150266	65110	374252	0.92	1.13	0.75
1990	198044042	350054629	112043777	104089	173079	62598	163224	0.54	0.67	0.44
1991	124149867	225094659	68474257	159692	254263	100295	274839	0.65	0.80	0.52
1992	257878732	448084201	148412821	120451	198453	73108	87022	0.28	0.35	0.23
1993	190850317	333350948	109265757	194464	298962	126491	200123	0.55	0.68	0.45
1994	180456444	323687689	100604778	234685	369792	148941	267281	0.56	0.69	0.46
1995	153314205	276694775	84950088	140225	216789	90701	213168	0.44	0.55	0.36
1996	742104035	1270032485	433625443	234451	355601	154575	159304	0.46	0.57	0.37
1997	63910869	113888005	35865052	185350	253765	135379	474093	0.83	1.03	0.67
1998	93175931	165307428	52518839	331373	528129	207919	474843	1.10	1.38	0.89
1999	121448395	213758123	69001882	108662	173244	68155	193621	0.85	1.18	0.62
2000	133953060	244295178	73449761	68665	105592	44653	196525	0.75	1.01	0.55

Year	Recruitment (age 0)	High	Low	SSB	High	Low	Total catch	F ages 1–2	High	Low
	thousands			tonnes			tonnes			
2001	127038405	228730898	70557832	76726	123535	47654	196209	0.58	0.83	0.41
2002	31960138	60479691	16889148	75660	127557	44877	115207	0.46	0.62	0.34
2003	72783512	134638053	39345783	71754	121412	42407	35365	0.27	0.36	0.195
2004	47110195	90165035	24614536	32048	50490	20343	33658	0.194	0.26	0.143
2005	80277505	144355577	44643081	65382	110917	38540	13994	0.086	0.116	0.063
2006	114949102	195037993	67747293	60114	95142	37982	7094	0.037	0.050	0.027
2007	58644245	97163113	35395608	104402	164332	66327	75376	0.22	0.30	0.165
2008	89701675	146182937	55043295	145365	227593	92845	74943	0.25	0.33	0.182
2009	137206823	217544555	86537272	103570	159865	67098	6161	0.021	0.028	0.0150
2010	15665948	27074762	9064602	247459	369038	165934	60542	0.27	0.36	0.198
2011	11106044	19302371	6390107	248451	379062	162844	92450	0.169	0.23	0.125
2012	84309069	142072104	50031069	167376	265196	105638	40141	0.103	0.139	0.076
2013	207159586	337954622	126984782	59934	92570	38804	9838	0.050	0.067	0.037
2014	223070852	355966153	139790271	113777	172072	75232	95426	0.20	0.27	0.148
2015	8121294	13978527	4718337	226160	345513	148036	104607	0.26	0.36	0.195
2016	705205636	1114483743	446229020	260146	399086	169578	44074	0.103	0.139	0.076
2017	32475613	54517311	19345515	202400	297048	137909	115642	0.23	0.31	0.169
2018	223741069	366412939	136621993	442856	692580	283175	75143	0.24	0.33	0.180
2019	303229348	506679863	181471663	275130	436111	173572	136901	0.37	0.50	0.27
2020	160691992	303021501	85214799	284077	439649	183555	247411	0.62	0.84	0.46
2021	77206947	216344460	27552879	375120	620220	226879	157752^	0.37	0.50	0.28
2022	112945768**			210029*	358096*	123185*				

\* Using mean weight-at-age from 2017 to 2021.

\*\* Geometric mean (1986–2020).

^ Preliminary.

## Sources and references

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[Download the stock assessment data and figures.](#)

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