

## 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 2021 should be no more than 161 335 tonnes.

### Stock development over time

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



**Figure 1** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. Summary of the stock assessment. The assumed recruitment value for 2021 is shaded in a lighter colour.

### Catch scenarios

**Table 1** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. The basis for the catch scenarios.

Variable	Value	Notes
F (2020)	0.66	From the assessment
Recruitment (2020)	232 406 837	From the assessment; in thousands
Recruitment (2021)	112 353 137	Geometric mean 1986–2019; in thousands
SSB (2021)	319 656	From the assessment; in 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 (2021)	F <sub>total</sub> (2021)	SSB (2021)	% SSB change *	% TAC change **	% advice change ***
ICES advice basis						
SSB <sub>2022</sub> ≥ MSY B <sub>escapement</sub> with F <sub>cap</sub>	161335	0.29	299368	-6.3	-39	4.0
Other scenarios						
F = 0	0	0	396106	24	-100	-100
SSB <sub>2022</sub> = B <sub>pa</sub> = B <sub>escapement</sub>	468489	1.20	129000	-60	79	202
SSB <sub>2022</sub> = B <sub>lim</sub>	569582	1.76	80000	-75	117	267
F <sub>2020</sub>	316361	0.66	207977	-35	21	104

\* SSB<sub>2022</sub> relative to SSB<sub>2021</sub>.

\*\* Catch scenario for 2021 relative to the TAC in 2020 (262 406 t – the sum of the Norwegian [250 000 t] and EU [12 406 t] TAC).

\*\*\* Advice value 2021 relative to advice value 2020 (155 072 t).

### Basis of the advice

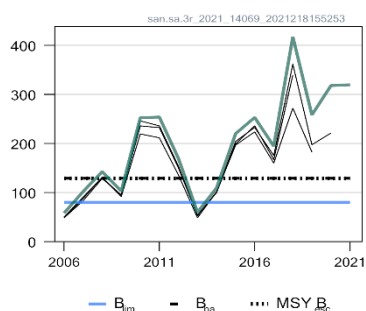
**Table 3** Sandeel in divisions 4.a–b and Subdivision 20, Sandeel Area 3r. The basis of the advice.

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

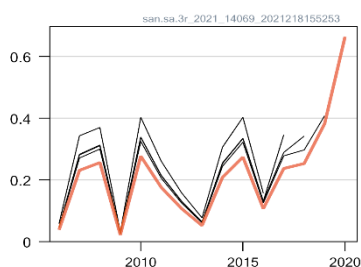
### Quality of the assessment

This stock was inter-benchmarked in 2020 because the assessment has a tendency to overestimate both recruitment and SSB when recruitment is above average (ICES, 2020). 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.

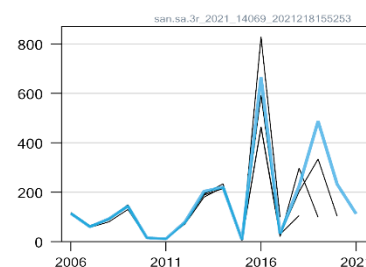
**SSB (thousand tonnes)**



**F (ages 1-2)**



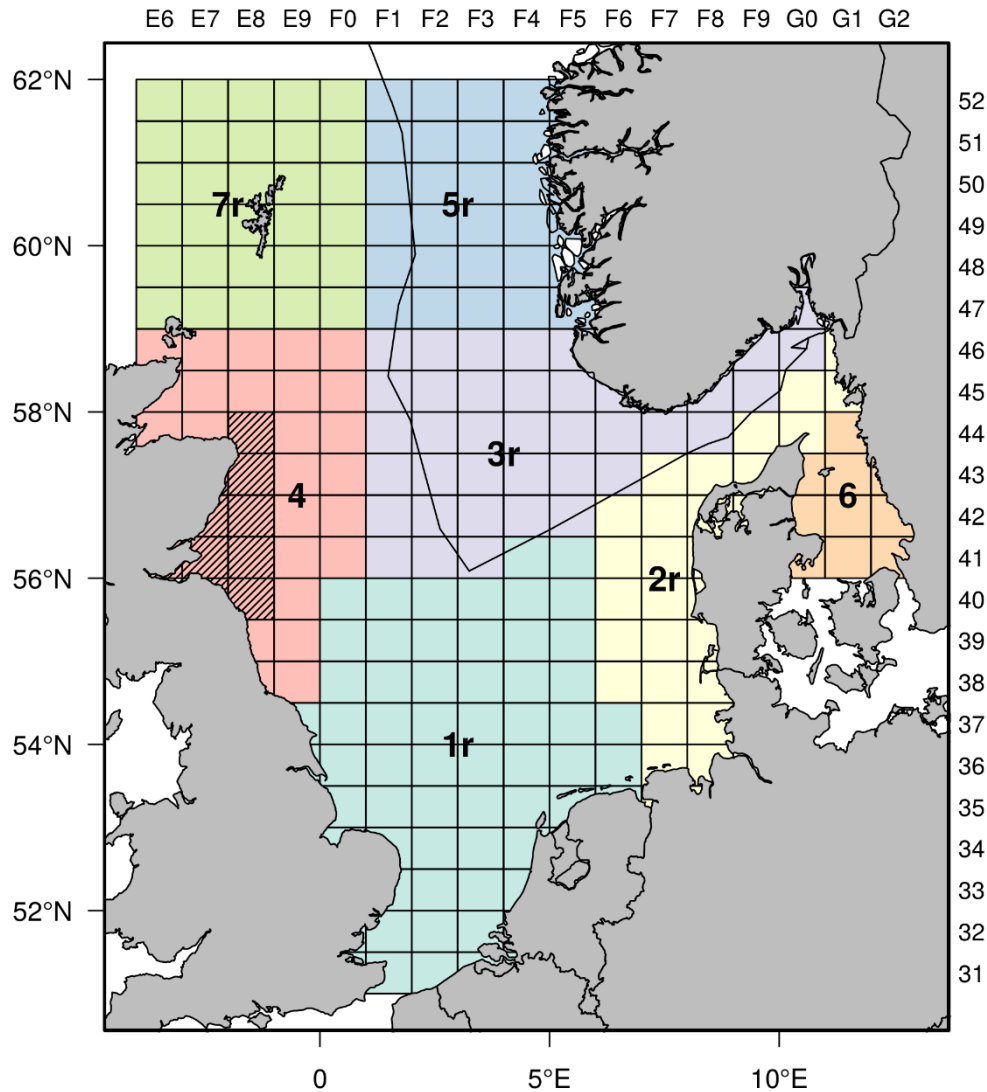
**Rec (age 0; Billions)**



**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

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 evaluated this management measure.



**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 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 < 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 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, 2021a</a> )
Assessment type	Age-structured model (SMS-effort), half-yearly time-step (ICES, 2021b)
Input data	Acoustic survey index (D9376) (2010–2020) and dredge survey index (2005–2020). 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, 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	44076	75405
2017^	MSY approach: allow for sufficient stock ( $MSY B_{escapement}$ ) to remain for successful recruitment.	$\leq$ 74176	0	120000		115642	517498

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)
2018 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment.	≤ 108365	8669	70000		74933	270858
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		247646 <sup>^^</sup>	447349 <sup>^^</sup>
2021 <sup>^</sup>	MSY approach: allow for sufficient stock (MSY B <sub>escapement</sub> ) to remain for successful recruitment.	≤ 161335					

\* 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 2020 as estimated by ICES (in tonnes).

Total catch (2020)	Landings	Discards
247646	100% industrial trawl fisheries	Discarding is considered negligible.
	247646	

**Table 8** 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

Year	Catch
2008	74992
2009	6362
2010	61243
2011	92452
2012	40134
2013	9844
2014	95464
2015	104631
2016	44076
2017	115642
2018	74933
2019	136901
2020	247646*

\* Preliminary

**Summary of the assessment**

**Table 9** 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. 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			
1986	509530362	876984641	296038468	73865	126473	43140	282315	0.45	0.56	0.35
1987	116919942	211439385	64653389	181680	287229	114917	395296	0.61	0.75	0.50
1988	359419217	632718782	204169968	264342	408919	170882	330358	0.82	1.01	0.67
1989	107715064	192151632	60382183	98716	149549	65161	350409	0.92	1.13	0.75
1990	197056294	349037157	111252289	103673	172031	62478	163224	0.54	0.67	0.44
1991	124647461	226424776	68618770	159054	252637	100137	274839	0.65	0.80	0.52
1992	258395005	449690860	148475285	119850	197194	72843	86788	0.28	0.35	0.23
1993	190468998	333139455	108898657	194464	298878	126527	175786	0.55	0.68	0.45
1994	179376947	322312907	99828733	234685	369725	148968	267281	0.56	0.69	0.46
1995	154391169	279593459	85254617	139804	215887	90535	173607	0.45	0.55	0.36
1996	751062929	1289770236	437361251	233515	353518	154247	159024	0.46	0.57	0.37
1997	64167025	114762809	35877538	186093	254971	135821	470670	0.83	1.03	0.68
1998	93082802	165580155	52327575	334035	534266	208846	462081	1.11	1.38	0.89
1999	121084596	213419522	68697930	109316	174132	68626	191253	0.88	1.22	0.64
2000	132090784	241077267	72375033	67171	103290	43682	186837	0.78	1.05	0.57
2001	124398415	224627035	68891822	74608	120286	46276	193684	0.60	0.86	0.42
2002	31202226	59189386	16448539	73571	124291	43548	116298	0.48	0.65	0.35
2003	70844649	131786490	38084058	69148	117640	40644	34673	0.28	0.37	0.20
2004	45672184	87836579	23748060	30822	48853	19447	31285	0.20	0.28	0.147
2005	78530685	142490841	43280456	63196	108077	36953	13991	0.089	0.121	0.066
2006	114033178	195550980	66497062	58105	92573	36470	7094	0.038	0.052	0.028
2007	60128831	100262346	36060161	101926	161731	64236	74972	0.23	0.31	0.170
2008	92525977	150584799	56852063	142629	225807	90090	74933	0.26	0.35	0.188
2009	143235402	228113929	89939182	102950	160559	66012	6261	0.022	0.029	0.0160
2010	15263883	26036289	8948515	252458	378841	168237	61241	0.28	0.38	0.20
2011	11285170	19387860	6568804	253723	392170	164152	92452	0.176	0.24	0.129
2012	79319932	133695524	47059553	169397	272257	105398	40116	0.107	0.145	0.079
2013	203667638	329530908	125877440	59755	93550	38168	9844	0.052	0.070	0.038
2014	220851260	350937444	138985679	109426	165629	72294	90876	0.21	0.28	0.153
2015	7333768	12833657	4190867	220136	336697	143927	104631	0.27	0.37	0.20
2016	665467261	1071308882	413369741	252963	390160	164011	42845	0.107	0.145	0.079
2017	32184644	53560733	19339752	194464	290125	130344	115642	0.24	0.32	0.175
2018	224188999	380501636	132090647	417483	668484	260728	75143	0.25	0.34	0.186
2019	487597096	929727101	255721198	258074	420468	158400	135899	0.38	0.52	0.28
2020	232406837	690137756	78263995	318061	509950	198379	246825	0.66	0.90	0.49
2021	112353137**			319656*	595432	171606				

\* Using mean weight-at-age from 2016 to 2020.

\*\* Geometric mean (1986–2019).

## Sources and references

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