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Sandeel (*Ammodytes* spp.) in divisions 4.a–b, Sandeel Area 4 (northern and central North Sea)

ICES stock advice

ICES advises that when the MSY approach is applied, catches in 2017 should be no more than 54 043 tonnes.

However, a closed area exists in this region and ICES advises to not take the full catch in the open banks as this will increase the risk of local depletion. ICES is not in a position to advise on the magnitude of the associated catch.

Stock development over time

Fishing mortality (F) has been very low since 2006 and sandeels were only fished in a monitoring fishery. Spawning-stock biomass (SSB) has increased from the time-series low in 2009 to levels well above precautionary reference points (B_{pa} = MSY $B_{escapement}$) and has remained at this level since 2011, with one exception (2015). Two large year classes (2009 and 2014) drove the increase in SSB, and the 2016 year class is estimated to be well above the long-term average. Uncertainty in SSB and recruitment estimates is large in the most recent years.

Figure 1 Sandeel in divisions 4.a–b, Sandeel Area 4. 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.a–b, Sandeel Area 4. State of the stock and fishery relative to reference points.

	Fishing pressure					Stock size				
		2014	2015	2016			2015	2016	2017	
Maximum sustainable yield	F_{MSY}	?	?	?	Unknown	MSY $B_{escapement}$	✗	✓	✓	Above escapement
Precautionary approach	F_{pa}, F_{lim}	?	?	?	Unknown	B_{pa}, B_{lim}	o	✓	✓	Full reproductive capacity
Management plan	F_{MGT}	-	-	-	Not applicable	SSB_{MGT}	-	-	-	Not applicable

Catch options

Table 2 Sandeel in divisions 4.a–b, Sandeel Area 4. The basis for the catch options.

Variable	Value	Source	Notes
F (2016)	0.0189	ICES (2017a)	Sum of half-yearly Fs
Recruitment (2016)	168862340	ICES (2017a)	In thousands
Recruitment (2017)	53253913	ICES (2017a)	Geometric mean (2006–2015), in thousands
SSB (2017)	188096	ICES (2017a)	In tonnes

Table 6.3.44.3 Sandeel in divisions 4.a–b, Sandeel Area 4. Annual catch options. All weights are in tonnes.

Basis	Total catch (2017)	F_{total} (2017)	SSB (2018)	% SSB change *	% TAC change **
ICES advice basis					
$SSB_{2018} \geq$ MSY $B_{escapement}$ with F_{cap}	54043	0.15	180855	−3.9	801
Other options					
F = 0	0	0	214259	13.9	−100
F_{pa}	Not applicable				
F_{lim}	Not applicable				
SSB_{2018} = MSY $_{Bescapement}$ = B_{pa}	188221	0.682	102000	−46	3037
B_{lim}	291482	1.455	48000	−74	4758
F = F_{2016}	7339	0.0189	209681	11.5	22

* SSB 2018 relative to SSB 2017.

** Catch option for 2017 relative to TAC in 2016.

Basis of the advice

Table 4 Sandeel in divisions 4.a–b, Sandeel Area 4. 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

This stock was benchmarked in the period between the 2016 and 2017 assessments. For the first time in 2017 an analytical assessment (category 1) was available as sufficient samples had been collected through the implementation of the monitoring TAC. The number of samples from the monitoring fishery and the areas fished were quite limited in the mid-2000s. The dredge survey that is used in the assessment is of good quality but is relatively short (2008–2016). The quality of the assessment will likely improve once longer time-series of dredge survey and adequate commercial sampling become available.

Issues relevant for the advice

Catch advice for 2017 is much higher than in recent years. Parts of the sandeel banks in Sandeel Area 4 (SA4) are closed for fisheries (STECF, 2007). The assessment and reference points are based on the entire stock, including those sandeels that are distributed in the closed areas. There is exchange of sandeels between the closed and open banks in SA4, but sandeel movement is limited. Consequently, taking the full catch in the open banks will increase the risk of local depletion.

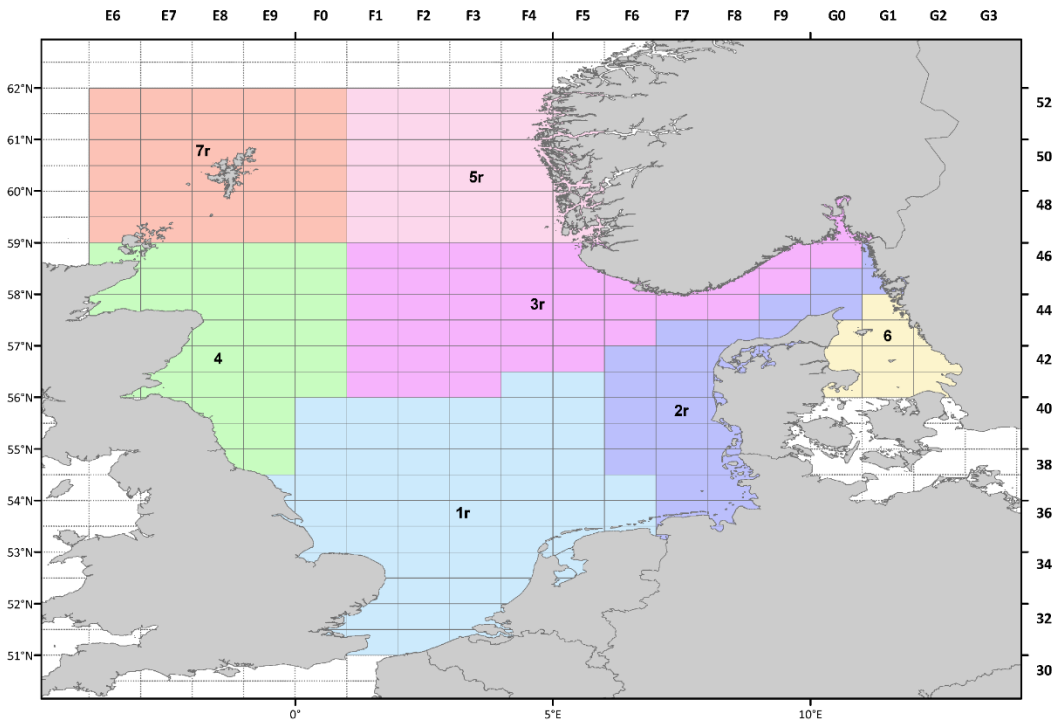

Figure 2 Sandeel in divisions 4.a–b, Sandeel Area 4. Sandeel are largely sedentary after settlement and form a complex of local (sub-)stocks in the North Sea. To avoid local depletion, ICES advice for sandeel is provided separately for seven areas in Division 3a and Subarea 4. Advice for sandeel in divisions 4.a–b, Sandeel Area 4 is defined by rectangles 38–40 E7–E9 and 41–46 E6–F0. ICES revised many of the sandeel areas by ICES statistical rectangle at the 2016 benchmark; however, Sandeel Area 4 was not revised (ICES, 2017a).

Reference points

Table 5 Sandeel in divisions 4.a and 4.b, Sandeel Area 4. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{escapement}$	102000 t	= B_{pa}	ICES (2017a)
	F_{MSY}			
	F_{cap}	0.15	Maximum F estimated from MSE that results in less than 5% probability of SSB < B_{lim}.	ICES (2017a)
Precautionary approach	B_{lim}	48000 t	Average SSB of two lowest SSB estimates providing high recruitment (2003, 2009)	ICES (2017a)
	B_{pa}	102000 t	$B_{pa} = B_{lim} \times \exp(\sigma \times 1.645)$, with $\sigma = 0.46$ estimated from assessment uncertainty in the terminal year	ICES (2017a)
	F_{lim}	Not defined		
Management plan	SSB_{MGT}	Not defined		
	F_{MGT}	Not defined		

Basis of the assessment

Table 6 Sandeel in divisions 4.a and 4.b, Sandeel Area 4. The basis of the assessment.

ICES stock data category	1 (ICES, 2016)
Assessment type	Analytical seasonal age-based (SMS-effort; ICES, 2017b)
Input data	One survey index available in January (dredge survey). Total international catch and fishing effort. Fixed maturity data. Natural mortality estimated from multispecies assessment (assumed constant over time). Age and length frequencies from catch sampling.
Discards and bycatch	Discarding is considered to be negligible.
Indicators	None
Other information	Last benchmarked in 2016 (ICES, 2017a).
Working group	Herring Assessment Working Group (HAWG)

Information from stakeholders

There is no available information.

History of advice, catch, and management

Table 7 Sandeel in divisions 4.a–b, Sandeel Area 4. 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 4	Total ICES catch (SAs 1r–7r)
2005*	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class.	-	661000**	1557	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**	55	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**	11	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**	1168	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	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**	275	414000
2011	A TAC at 5000–10 000 tonnes will impose a low risk of overfishing sandeel in this area.	5000–10000	10000	272	438000
2012	Catches for monitoring purposes should not exceed 5000 t.	< 5000	5000	2585	102000
2013	Catch of 2012 reduced by 20% as a precautionary buffer.	< 2041	4000	5225	278000
2014	Catches for monitoring purposes should not exceed 5000 t (with associated sampling protocol).	< 5000	5000	4414	264000
2015	Catches for monitoring purposes should not exceed 5000 t (with associated sampling protocol).	< 5000	5000	4392	312000
2016	Precautionary approach	≤ 6000	6000	5770***	73420***
2017	MSY approach: allow for sufficient stock ($MSY\ B_{escapement}$) to remain for successful recruitment.	≤ 54043			

* Advice for Subarea 4, excluding the Shetland area.
** Set for EU waters of Divisions 2.a and 3.a and Subarea 4.
*** Preliminary.

History of catch and landings

Table 8 Sandeel in divisions 4.a–b, Sandeel Area 4. Catch distribution by fleet in 2016 as estimated by ICES (in tonnes).

Total catch (2016)	Landings	Discards
5770	100% industrial trawl fisheries	Negligble
	5770	

Table 9 Sandeel in divisions 4.a–b, Sandeel Area 4. History of total catch (in tonnes) as estimated by ICES.

Year	Catch
1983	2782
1984	2563
1985	38122
1986	12718
1987	8154
1988	1338
1989	4384
1990	3314
1991	41372
1992	68905
1993	133136
1994	158690
1995	52591
1996	158490
1997	58446
1998	58746
1999	53334
2000	37792
2001	47883
2002	12761
2003	63790
2004	6882
2005	1557
2006	55
2007	11
2008	1168
2009	0
2010	275
2011	272
2012	2585
2013	5225
2014	4414
2015	4392
2016	5770

Summary of the assessment

Table 10 Sandeel in divisions 4.a–b, Sandeel Area 4. Assessment summary. The assessment uses an abundance index from the Scottish December dredge survey in the Firth of Forth (with each age standardized to its long-term mean in the survey, and averaged over ages 0 and 1). Empty cells denote that no data were collected.

Year	Recruitment Age 0	High	Low	SSB	High	Low	Total catch	F per year	High	Low
	thousands			tonnes			tonnes	Ages 1–2		
1993	117704375	190164804	72854280	374690	587763	238859	132599	0.41	0.62	0.21
1994	263779886	440268356	158039585	161290	292791	88850	158690	0.48	0.72	0.24
1995	71238560	119669724	42407823	131850	250125	69503	52591	0.141	0.21	0.070
1996	388422402	658213774	229214229	262860	457453	151044	158490	0.31	0.48	0.150
1997	99472585	183066244	54050353	87883	179164	43108	58446	0.179	0.27	0.089
1998	44729770	81366096	24589509	272790	488036	152477	58746	0.191	0.29	0.095
1999	243265893	413681045	143052952	206020	381107	111371	53334	0.27	0.41	0.138
2000	206645883	347178695	122998679	90585	190681	43033	37714	0.136	0.20	0.068
2001	25013560	43148035	14500734	119830	220078	65246	47902	0.21	0.32	0.107
2002	90984425	155155065	53354143	132580	245047	71731	12736	0.045	0.068	0.023
2003	155501712	279131931	86628507	75326	137236	41345	63731	0.34	0.51	0.172
2004	13186910	43198081	4025517	67690	139769	32782	6882	0.065	0.098	0.033
2005	13144300	***	48117	86716	159498	47146	1557	0.029	0.043	0.0140
2006	7685251	***	0	87618	160866	47722	0	0	0	0
2007	11483358	26928181	4897008	49499	140714	17412	0	0	0	0
2008	32517647	70316626	15037658	28208	113944	6983	0	0	0	0
2009	466809824	997715131	218410451	25084	82931	7587	0	0	0	0
2010	78288749	162116693	37806892	31181	69329	14024	0	0	0	0
2011	55784322	114512829	27175039	285760	606049	134739	0	0	0	0
2012	49060717	101560898	23699613	169490	349099	82289	2585	0.022	0.033	0.0110
2013	32228347	67123409	15473981	161950	332919	78781	5225	0.0120	0.0180	0.0060
2014	358693246	733223345	175472925	134730	273105	66466	4314	0.0160	0.024	0.0080
2015	55287004	115332582	26502943	70671	143175	34883	4392	0.0130	0.0190	0.0060
2016	168862340	395190480	72153787	283840	573465	140488	5763	0.024	0.035	0.0120
2017	53253913*			188100**	379876	93140				
Avg	124763123	260830092	67599780	143449.64	278169	75240	36071	0.121	0.182	0.061

* Geometric mean (2006–2016).
** Mean weight-at-age (2012–2016).
*** Extremely high upper bounds estimated by the model.

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