6.4.22 Sandeel in Subarea IV excluding the Shetland area

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to highest yield	Fishing mortality in relation to agreed target	Comment
Increased risk	Undefined	Undefined	Undefined	

According to the most recent estimate of SSB (2009), ICES classifies the stock as being at risk of reduced reproductive capacity. Fishing mortality decreased between 2001 and 2007 and increased in 2008 and 2009, but the present absolute level is uncertain. In the absence of an F reference point, the state of the stock cannot be evaluated with regard to sustainable harvest.

Management objectives

There are no explicit management objectives for this stock.

Reference points

	Type	***Value***	***Technical basis***
Precautionary approach	B_{lim}	430 000 t	The lowest observed biomass in the period 1976–1998.
	B_{pa}	600 000 t	$B_{pa} = 1.4 * B_{lim}$.
	F_{lim}	Not defined.	
	F_{pa}	Not defined.	
Targets	F_y	Not defined.	

(unchanged since 1999)

Single-stock exploitation boundaries

Considering the options below, ICES advises on the basis of exploitation boundaries in relation to precautionary limits that fishing grounds that are known to be commercially depleted should be closed to fishing while at non-depleted fishing grounds fishing should only be allowed in 2010 if analysis of real-time monitoring indicates that the stock can be rebuilt to B_{pa} by 2011

Exploitation boundaries in relation to high long-term yield, low risk of depletion of production potential and considering ecosystem effects

The management of sandeel fisheries should implement measures to prevent depletion of local aggregations, particularly in areas where predators congregate.

Exploitation boundaries in relation to precautionary limits

ICES recommends that fishing grounds that are known to be commercially depleted should be closed to fishing until there is evidence from monitoring programmes that local populations have recovered. On other fishing grounds, a fishery should only be allowed in 2010 if analysis of real-time monitoring indicates that the stock can be rebuilt to B_{pa} by 2011.

Management considerations

The high natural mortality of sandeel and the few year classes in the fishery make the stock size and catch opportunities largely dependent on the size of the incoming year classes.

If a real-time management using an escapement strategy is applied in 2010, the escapement target should be defined so that the SSB reaches at least B_{pa} in 2011. Fishing grounds that are known to be commercially depleted should be closed to fishing until there is evidence that local populations have recovered.

ICES recommends that future management should take account of the spatial structure of sandeels. Sandeel management in the North Sea is based on the assumption that there is a single stock when there is strong evidence of a number of spatially distinct (sub-)stocks. The full stock structure of sandeel in the North Sea, however, remains unclear. It is known that (sub-)stocks on the Viking/Bergen Banks, in the western North Sea off Scotland, and the (separately-managed) Shetland stock are all distinct. The present knowledge on defining (sub-)stocks off south-western Norway and in the southern North Sea is too limited to recommend specific management measures for 2010 which can take the full stock structure into account.

Impacts of fisheries on the ecosystems

Local depletion of sandeel aggregations at a distance less than 100 km from seabird colonies may affect some species of birds, especially black-legged kittiwake (*Rissa tridactyla*) and sandwich tern (*Sterna sandvicensis*), whereas the more mobile marine mammals and fish may be less vulnerable to local sandeel depletion. In the light of studies linking low sandeel availability to poor breeding success of kittiwake, all commercial fishing in the Firth of Forth area has been prohibited since 2000, except for a short-term fishery in May and June of each year for stock monitoring purposes.

A major function of sandeels in the North Sea ecosystem is the provision of food to predators, including fish, marine mammals, and seabirds. The management objectives should ensure that the stock remains high enough to provide food for predator species and prevent depletion of local aggregations, particularly in areas of predator concentration. The sandeel fishery in the area off the Scottish coast that was closed to sandeel fishery in 2000, should continue to be closed in 2010 in view of the current low productivity of the sandeel (sub-)stock in this area and to provide, as far as possible, a food supply to dependent predators. In other areas of the North Sea, avoidance of depletion at a local scale will help take account of the function of sandeels in the ecosystem.

Factors affecting the fisheries and the stock

Regulations and their effects

Regulation of the catch by the sandeel fishery has since 2004 been based on the abundance of 1-group sandeels, estimated from an exploratory fishing in the beginning of the fishing season.

The number of Danish vessels has declined from 200 vessels in 2004 to 84 in 2009, and a 43% reduction in total kilowatt days for the same period. In 2007, the Danish industrial vessels were given individual tradable quotas (ITQ) on sandeel and this caused a change towards fewer and larger vessels. The Norwegian fleet fishing for sandeel declined from 90 to 33 vessels between 2002 and 2009.

In May 2009, ICES suggested a TAC of 400 000 tonnes on the basis of the real-time monitoring in April. The resulting TAC was not fully taken, recorded landings totalled 350 000 t.

Impacts of the environment on the fish stock

There are indications that the egg production in prey copepod species *Calanus finmarchicus* supports the survival of sandeel larvae, and that climate-generated shifts in the *Calanus* species composition lead to a mismatch in timing between food availability and the early life history of lesser sandeels (van Deurs *et al.*, 2009).

Changes in fishing technology and fishing patterns

Sandeel is taken by trawlers using small-mesh gear. The fishery is seasonal, taking place mostly in the spring and summer. There used to be a targeted 0-group fishery in autumn (3rd quarter), but this ceased in 2004. Most of the catch consists of *Ammodytes marinus*, but other sandeel species are caught as well. There is a low percentage bycatch of other fish species, including species for which a TAC has been set (ICES, 2003).

Sandeel are largely stationary after settlement and there is a complex of local (sub-)stocks in the North Sea. Recruitment to individual fishing banks may not only be related to the local (sub-)stock, as some interchange between (sub-)stocks may take place during the early phases of life before settlement. The Shetland sandeel stock is assessed as a separate unit.

Concurrent with the increase in the total stock size, some areas especially in the northern North Sea with recent very low abundance have been repopulated in 2006 and 2008. Evidence however suggests that abundance following fisheries in 2008 in these areas is now again at a low level, and no sandeel fishery was allowed in the Norwegian EEZ in 2009.

Scientific basis

Data and methods

The assessment of sandeel is carried out without fisheries-independent indices of abundance. At present no scientific surveys time-series are available that can be used for the assessment.

The assessment method used is Seasonal XSA (SXSA), which allows the use of semi-annual data. As in previous assessments, effort data from the commercial fishery in the northern and southern North Sea are treated as two independent tuning fleets, separated into half-years.

Uncertainties in assessment and forecast

The major elements of recent recruitment and stock development are being captured in the assessment, but details in recent years are uncertain due to:

- the assumption that there is a single North Sea stock;
- lack of fisheries-independent tuning data;
- large changes in fishing pattern in recent years; and
- possible large changes in catch efficiency in recent years.

The assessment used to provide the stock status assumes equal weight for fleets fishing in the north and south of the North Sea. However in recent years, a decreasing proportion of the effort has been located within the north due to closures in the Norwegian EEZ. The assessment estimates are sensitive to the distribution of effort and exploratory assessments have highlighted that the most recent dynamics of SSB and F are sensitive to these assumptions. The resulting range of biomass estimates in 2009 spans B_{lim} to above B_{pa}. The advice is based on the assessment procedure as used in previous years. A further evaluation of the assessment approach is needed to remedy these uncertainties.

Recruitment time-series estimates from surveys are not yet available, but the time-series are being developed. A first review of some of these data by ICES concludes that the surveys have the potential to provide indices of recruitment on both local and subarea scale. Recruitment estimates are presently based exclusively on commercial catch-at-age data.

Comparison with previous assessment and advice

The historical comparison of the advice shows a tendency to overestimate SSB and underestimate F.

The advice is similar to last year's advice.

Source of information

ICES. 2003. Report of the ICES Advisory Committee on Ecosystems. ICES Cooperative Research Report, 262: 152-176.

ICES. 2009. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak, 6-12 May 2009 (ICES CM 2009/ACFM:10).

van Deurs, M.,Hal, R. van; Tomczak, M.T. Jonasdottir, S.H. Dolmer, P. 2009. Recruitment of lesser sandeel *Ammodytes marinus* in relation to density dependence and zooplankton composition. Marine Ecology Progress Series 381: 249-258.

Table 6.4.22.1 Sandeel in Subarea IV. Single stock exploitation boundaries (advice), management and catch.

Year	Single-stock exploitation boundaries / from 2004 onwards ICES Advice	Catch corresponding to exploitation boundaries / advice	TAC [3]	ICES Catch
1987	No advice[1]; No advice[2]			825
1988	No advice[1]; No advice[2]			893
1989	No advice[1]; No advice[2]			1039
1990	No advice[1]; No advice[2]			591
1991	No advice[1]; No advice[2]			843
1992	No advice[1]; No advice[2]			855
1993	No advice[1]; No advice[2]			579
1994	No advice[1]; No advice[2]			786
1995	Can sustain current F[1]; No advice[2]			918
1996	Can sustain current F			777
1997	Can sustain current F			1138
1998	Can sustain current F		1000	1004
1999	Can sustain current F		1000	735
2000	Can sustain current F		1020	699
2001	Can sustain current F		1020	862
2002	Can sustain current F		1020	811
2003	No increase in F		918	326
2004	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2003 year class	-	826	362
2005	Exploitation to be kept below level of 2003. Adjustment to be made conditional on the abundance of the 2004 year class	-	661	172
2006	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2007.	-	300	288
2007	The fishery should remain closed until information is available which assures that the stock can be rebuilt to B_{pa} by 2008.	-	173[4]	206
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.	-	400[5]	335
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	-	400	
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	-		

Weights in '000 t.
[1] Southern stock component.
[2] Northern stock component.
[3] Set for zone IIIa, EC waters of Division IIa and Subarea IV.
[4] EU and Norway, set at 30 June 2007.
[5] EU and Norway, set at 23 July 2008.

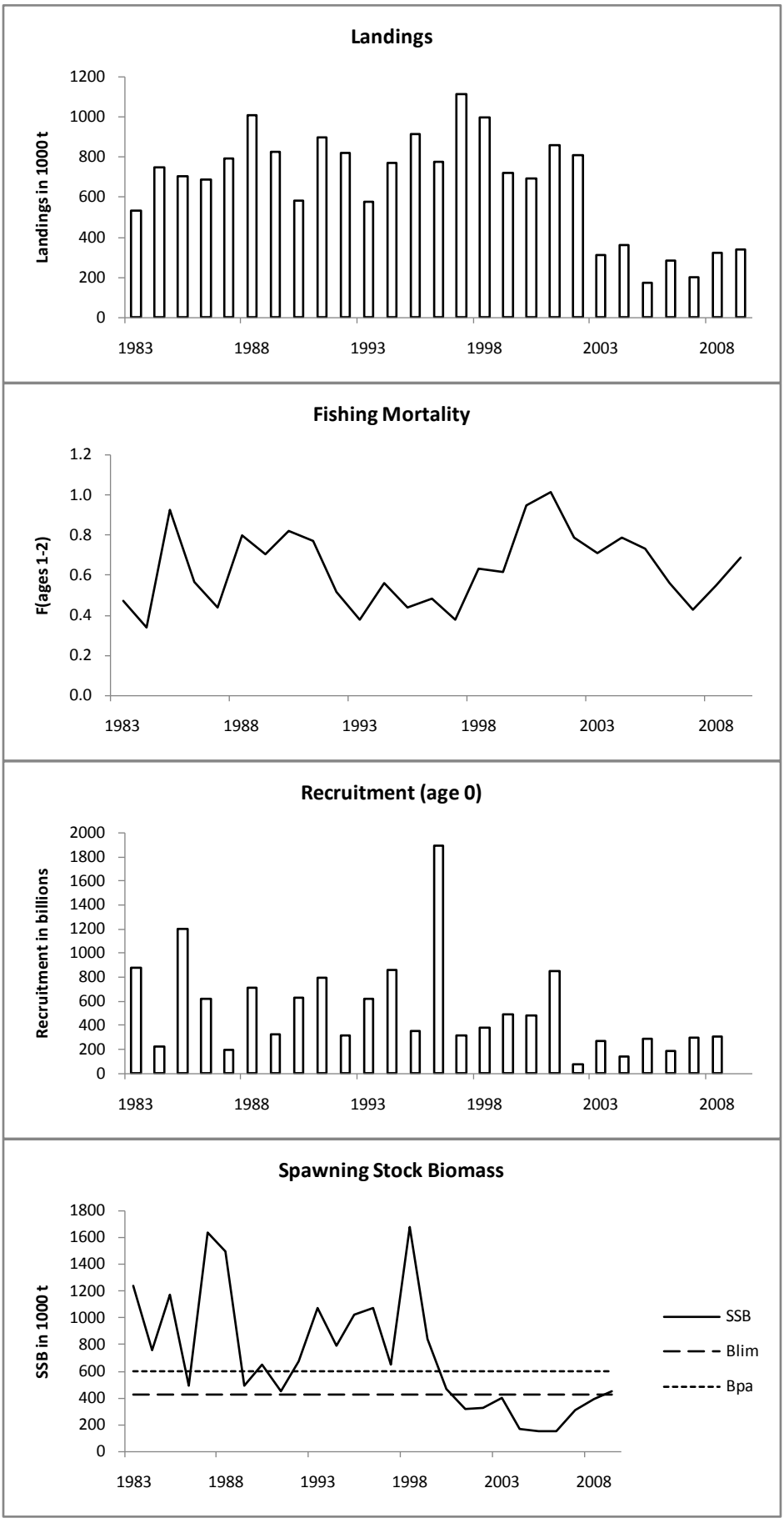

Figure 6.4.22.1 Sandeel in Subarea IV. Stock summary.

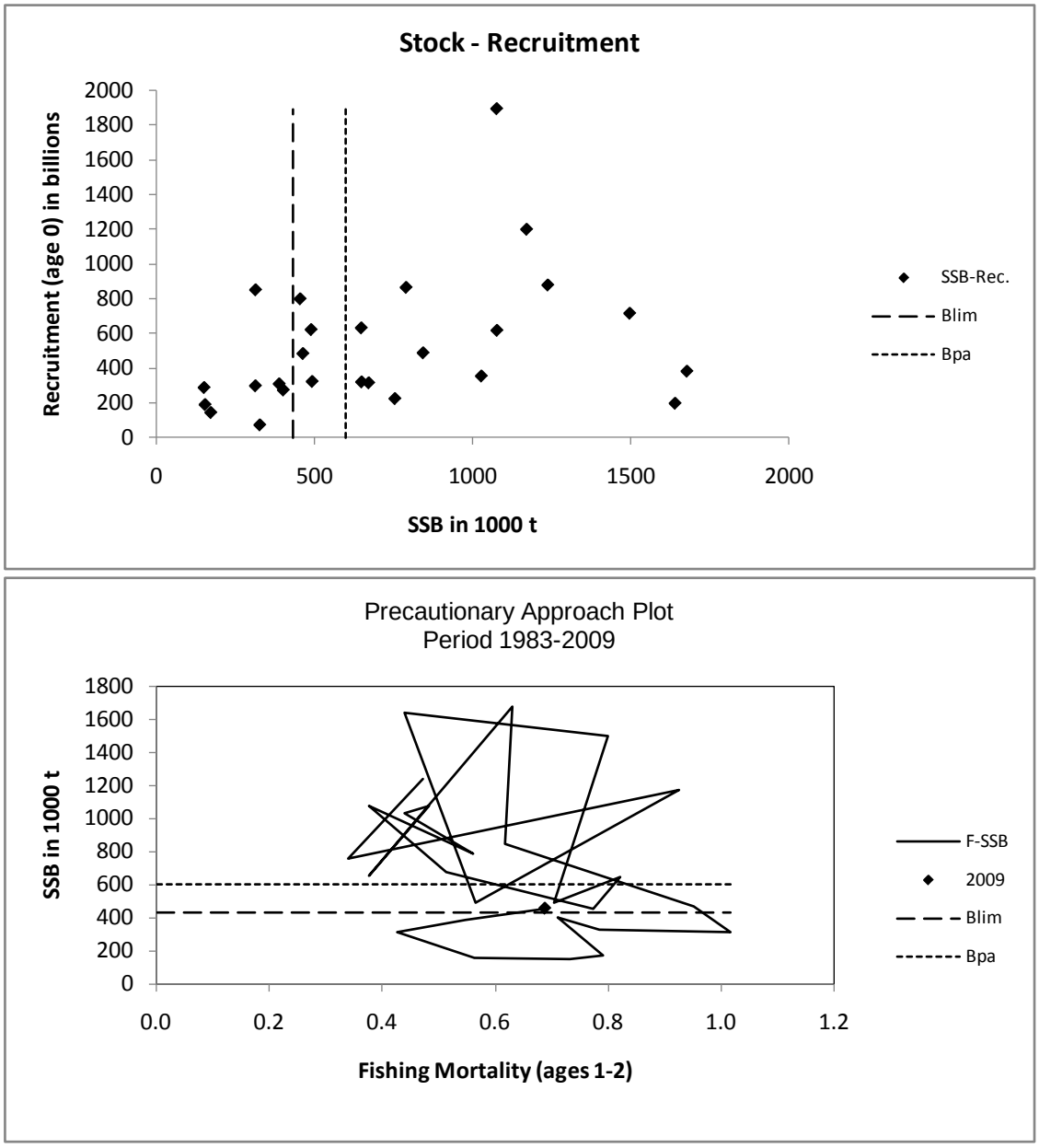

Figure 6.4.22.2 Sandeel in Subarea IV. Stock–recruitment plot and precautionary approach plot.

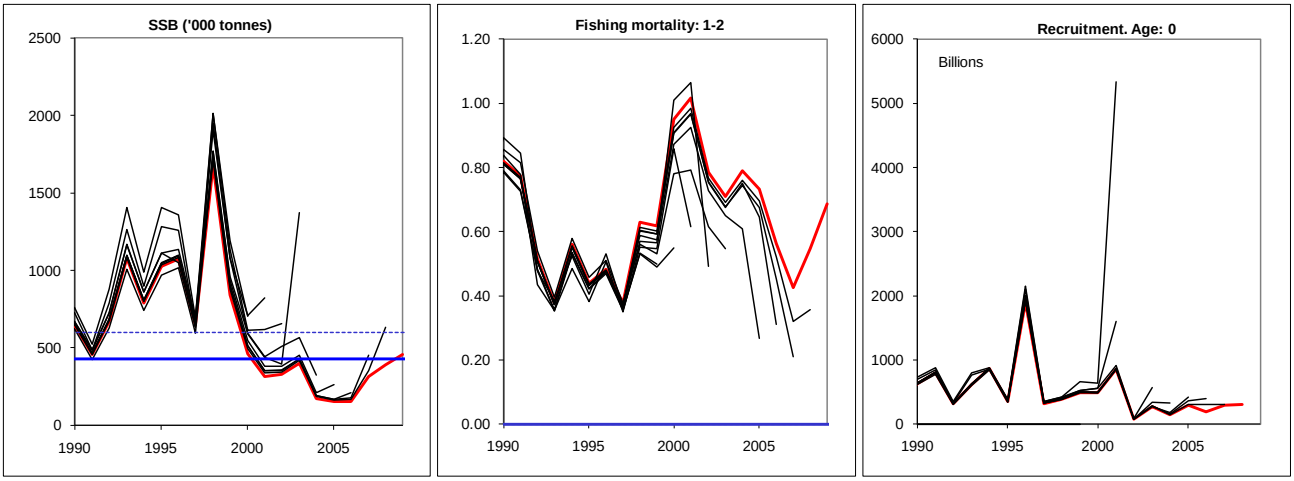

Figure 6.4.22.3 Sandeel in Subarea IV. Comparison of historical performance of assessments.

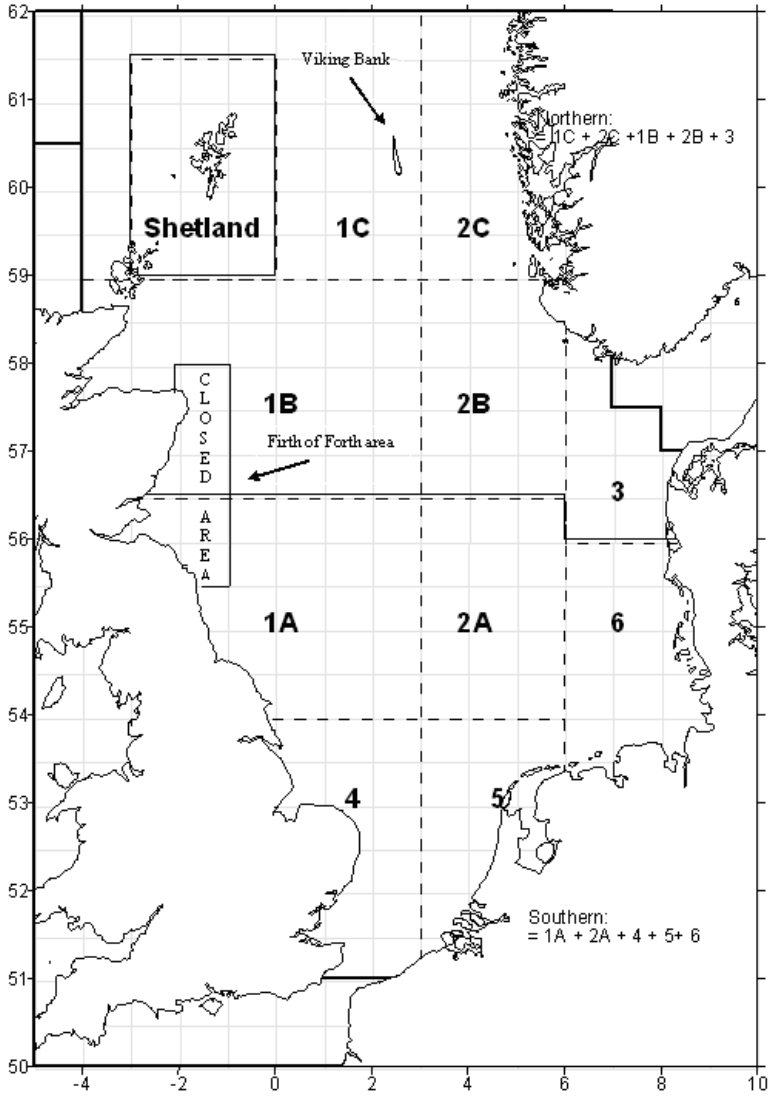

Figure 6.4.22.3 Sandeel in Subarea IV. Data sampling areas.

Table 6.4.22.2 Sandeel in Subarea IV. Official landings (tonnes) by country and Subdivisions reported to ICES.

SANDEELS IVa

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	4,742	1,058	111	399	147	-	-	1,873	958
Faroe Islands	-	-	-	-	15	-	-		
Norway	11,522	4,121	185	280	64	-	-		20,332
Sweden	55	-	-	73	-	-	-	21	
UK (E/W/NI)	-	-	-	-	-	-	-		
UK (Scotland)	4,781	970	543	186	-	-	-		
Total	21,100	6,149	839	938	226	0	0	1,894	21,290

*Preliminary.

SANDEELS IVb

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	533,905	638,657	627,097	245,096	273492	129776	241,257	142,309	240,689
Faroe Islands			16,167	5,168	3461	-	-	2,391	2,385
Germany	-	-	-	534	2658	-	3,304	1,989	
Ireland	-	-	-	-	-	-	-		
Norway	107,493	183,329	175,799	29,336	48464	17341	5,814	51,134	61,221
Sweden	27,867	47,080	36,842	21,444	34477	8327	32,709	6,721	12,405
UK (E/W/NI)	-	-	-	-	-	-	-		
UK (Scotland)	5,978	-	2,442	115	29	-	688	1,657	6,259
France								2	
Total	675,243	869,066	858,347	301,693	362,552	155,444	283,772	206,203	324,967

*Preliminary.

SANDEELS IVc

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008
Denmark	11,993	7,177	4,996	28,646	14,104	22,985	10,595	804	1,439
Germany	-	-	-	-	-	-	301		
France	1	-	-	-	+	-	2		1
Netherlands	-	-	+	-	-	-	-		
Norway	-	-	-	-	139	-	-		
Sweden	-	-	-	160	-	-	-		
UK (E/W/NI)	+	-	-	+	-	-	-		
Total	11,994	7,177	4,996	28,806	14,243	22,985	10,898	804	1,440

*Preliminary.

Summary table official landings

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total IV tonnes	708,337	882,392	864,182	331,437	377,021	178,429	294,670	208,901	347,697
TAC	1,020,000	1,020,000	1,020,000	918,000	826,200	660,960	300,000	173,000	400,000

By-catch and other landings

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Area IV tonnes: official-WG	9,188	20,781	53,482	5,817	15,521	6,329	6,770	2,601	12,497

Summary table - landing data provided by Working Group members

	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total IV - tonnes	699,149	861,611	810,700	325,620	361,500	172,100	287,900	206,300	335,200

Table 6.4.22.3 Sandeel in Subarea IV. Landings ('000 t) per country as provided by Working Group members.

Year	Denmark	Germany	Faroes	Ireland	Netherlands	Norway	Sweden	UK	Lithuania	Total
1952	1.6	-	-	-	-	-	-	-		1.6
1953	4.5	+	-	-	-	-	-	-		4.5
1954	10.8	+	-	-	-	-	-	-		10.8
1955	37.6	+	-	-	-	-	-	-	-	37.6
1956	81.9	5.3	-	-	+	1.5	-	-	-	88.7
1957	73.3	25.5	-	-	3.7	3.2	-	-	-	105.7
1958	74.4	20.2	-	-	1.5	4.8	-	-	-	100.9
1959	77.1	17.4	-	-	5.1	8.0	-	-	-	107.6
1960	100.8	7.7	-	-	+	12.1	-	-	-	120.6
1961	73.6	4.5	-	-	+	5.1	-	-	-	83.2
1962	97.4	1.4	-	-	-	10.5	-	-	-	109.3
1963	134.4	16.4	-	-	-	11.5	-	-	-	162.3
1964	104.7	12.9	-	-	-	10.4	-	-	-	128.0
1965	123.6	2.1	-	-	-	4.9	-	-	-	130.6
1966	138.5	4.4	-	-	-	0.2	-	-	-	143.1
1967	187.4	0.3	-	-	-	1.0	-	-	-	188.7
1968	193.6	+	-	-	-	0.1	-	-	-	193.7
1969	112.8	+	-	-	-	-	-	0.5	-	113.3
1970	187.8	+	-	-	-	+	-	3.6	-	191.4
1971	371.6	0.1	-	-	-	2.1	-	8.3	-	382.1
1972	329.0	+	-	-	-	18.6	8.8	2.1	-	358.5
1973	273.0	-	1.4	-	-	17.2	1.1	4.2	-	296.9
1974	424.1	-	6.4	-	-	78.6	0.2	15.5	-	524.8
1975	355.6	-	4.9	-	-	54.0	0.1	13.6	-	428.2
1976	424.7	-	-	-	-	44.2	-	18.7	-	487.6
1977	664.3	-	11.4	-	-	78.7	5.7	25.5	-	785.6
1978	647.5	-	12.1	-	-	93.5	1.2	32.5	-	786.8
1979	449.8	-	13.2	-	-	101.4	-	13.4	-	577.8
1980	542.2	-	7.2	-	-	144.8	-	34.3	-	728.5
1981	464.4	-	4.9	-	-	52.6	-	46.7	-	568.6
1982	506.9	-	4.9	-	-	46.5	0.4	52.2	-	610.9
1983	485.1	-	2.0	-	-	12.2	0.2	37.0	-	536.5
1984	596.3	-	11.3	-	-	28.3	-	32.6	-	668.5
1985	587.6	-	3.9	-	-	13.1	-	17.2	-	621.8
1986	752.5	-	1.2	-	-	82.1	-	12.0	-	847.8
1987	605.4	-	18.6	-	-	193.4	-	7.2	-	824.6
1988	686.4	-	15.5	-	-	185.1	-	5.8	-	892.8
1989	824.4	-	16.6	-	-	186.8	-	11.5	-	1039.1
1990	496.0	-	2.2	-	0.3	88.9	-	3.9	-	591.3
1991	701.4	-	11.2	-	-	128.8	-	1.2	-	842.6
1992	751.1	-	9.1	-	-	89.3	0.5	4.9	-	854.9
1993	482.2	-	-	-	-	95.5	-	1.5	-	579.2
1994	603.5	-	10.3	-	-	165.8	-	5.9	-	785.5
1995	647.8	-	-	-	-	263.4	-	6.7	-	917.9
1996	601.6	-	5.0	-	-	160.7	-	9.7	-	776.9
1997	751.9	-	11.2	-	-	350.1	-	24.6	-	1137.8
1998	617.8	-	11.0	-	+	343.3	8.5	23.8	-	1004.4
1999	500.1	-	13.2	0.4	+	187.6	22.4	11.5	-	735.1
2000	541.0	-	-	-	+	119.0	28.4	10.8	-	699.1
2001	630.8	-	-	-	-	183.0	46.5	1.3	-	861.6
2002	629.7	-	-	-	-	176.0	0.1	4.9	-	810.7
2003	274.0	-	-	-	-	29.6	21.5	0.5	-	325.6
2004	277.1	2.7	-	-	-	48.5	33.2	+	-	361.5
2005	154.8	-	-	-	-	17.3	-	-	-	172.1
2006	250.6	3.2	-	-	-	5.6	27.8	-	-	287.9
2007	144.6	1.0	2.0	-	-	51.1	6.6	1.0	-	206.3
2008	234.4	4.4	2.4	-	-	81.6	12.4	-	-	335.2
2009	285.7	12.2	2.5	-	1.8	27.4	12.4	3.6	2.0	347.7

* Preliminary

\+ = less than half unit.

\- = no information or no catch.

Table 6.4.22.4 Sandeel in Subarea IV. Monthly landings (tonnes) by Denmark, Norway, and Scotland only, from the areas defined in Figure 6.4.22.4. Data provided by Working Group members.

	1A	1B	1C	2A	2B	2C	3	4	5	6 Shetland		Total
2002												
Mar	3077	0	0	3911	2715	0	928	322	0	0	0	10953
Apr	104033	1745	0	66992	51007	0	15466	904	59	475	109	240790
May	176437	3341	0	78497	37385	0	37058	915	151	3272	12	337068
Jun	118879	125	0	27386	19380	10	10561	8673	2531	12498	0	200043
Jul	1128	0	0	90	48	0	193	2744	204	9869	0	14276
Aug	0	0	0	109	261	0	397	0	0	5146	422	6335
Sept	0	0	0	0	74	0	290	0	0	0	0	364
Oct	0	0	0	1	0	0	0	0	0	2	0	3
Dec	0	0	0	0	0	0	0	0	2	0	0	2
Total	403554	5211	0	176986	110870	10	64893	13558	2947	31262	543	809834
2003												
Mar	1947	52	0	97	380	7	225	325	0	0		3033
Apr	28806	5026	0	8341	6072	0	1900	81	0	662	49	50937
May	59890	1812	24	8884	9357	0	4532	10995	1020	9991	16	106521
Jun	11737	49	0	11906	398	10	2140	20891	13318	21639		82088
Jul	3604	0	0	9857	2013	0	3272	2738	1697	5790		28971
Aug	960	6	0	4381	4687	0	11293	16	175	687	121	22326
Sept	0	255	73	35	1551	0	2955	0	0	1094		5963
Oct	0	0	0	114	0	0	1589	0	0	127		1830
Nov	0	0	0	0	0	0	2070	0	0	0		2070
Dec	0	0	0	0	0	0	45	0	0	0		45
Total	106944	7200	97	43615	24458	17	30021	35046	16210	39990	186	303784
2004												
Feb	0	0	0	0	0	0	0	0	0	7		7
Mar	326	0	0	1001		0	37		260	2		1626
Apr	15893	627	0	15824	4847	0	10732	471	322	834		49550
May	46631	1044	0	21607	5495	0	22629	20484	233	8578		126701
Jun	21841	146	0	5077	1800	0	13821	13680	4789	35909		97063
Jul	1146	116		813	2272		6019	7430	1184	12923		31903
Aug	325			3963	5449		2589			3357		15683
Sept					3006		116			2		3124
Oct												
Total	86162	1933	0	48285	22869	0	55943	42065	6788	61612	0	325657
2005												
Apr	4017			71	1476		462	144		88		6258
May	34506	57		9536	7512		6507	13333	32	2410		73893
Jun	19216	21		8952	2545		8107	8224	19370	21959		88394
Jul				1668			987	922				3577
Aug				3			2					5
Sep												0
Okt										1		1
Total	57739	78	0	20230	11533	0	16065	22623	19402	24457	0	172128
2006												
Apr	10141			8733	1387		188	111		82		20642
May	96349			25020	3096		3830	201		6455		134951
Jun	59827	34		3184	47		4815	12035	5236	9506		94684
Jul	1122			94			3309	2600	1171	11745		20041
Aug				2			94			283		379
Sep				5			2			2		9
Oct					5		257					262
Nov		30										30
Total	167439	64	0	37038	4530	0	12495	14947	6407	28073	0	270998
2007												
Apr	23545			6378	19966		7098	646		406		58039
May	65238	308	4	4990	31062		22979	3024	244	1470		129319
Jun	501	69		50	4512		4032	25	559	2966		12714
Total	89284	377	4	11418	55540	0	34109	3695	803	4842	0	200072
2008												
April	20072	41		8148	10313		3884			460		42917
May	114280	9972		26263	29615		15986	1291		4700		204518
June	62816			3452	1599		10738	5152	384	3574		87715
July	1926			465			613	368	577	2823		6771
August				0			2			1		4
September				16			2			2		19
Total	199094	10013	0	38344	41527	0	31225	6810	961	11560	0	341945
2009												
April	42072			12774			1528			168		56542
May	126157	51		26225	976		5077	1364		3694		163544
June	17273			50825	1083		23876	4377	187	4126		101747
July	680			15492	0		9398			267		25836
Total	186182	51	0	105316	2059	0	39880	5742	187	8254	0	347670
%	54%	0%	0%	30%	1%	0%	11%	2%	0%	2%	0%	100%
Avera 02-09	162050	3116	13	60154	34173	3	35579	18061	6713	26256	91	346209

Table 6.4.22.5 Sandeel in Subarea IV. Assessment summary.

Year	Recruitment Age 0 Millions	SSB tonnes	Landings* tonnes	Mean F Ages 1-2
1983	878848	1236745	530641	0.471
1984	225599	754271	750040	0.340
1985	1199288	1169916	707105	0.925
1986	622401	489853	685949	0.566
1987	198475	1638389	791050	0.440
1988	716146	1495275	1007303	0.799
1989	324068	493162	826836	0.704
1990	632191	648117	584912	0.820
1991	799404	455214	898959	0.773
1992	316352	671540	820140	0.514
1993	618012	1076253	576932	0.377
1994	865131	789593	770746	0.560
1995	355327	1027068	915042	0.439
1996	1893077	1075400	776126	0.483
1997	321517	649068	1114044	0.377
1998	382990	1675811	1000376	0.630
1999	488704	843271	718667	0.617
2000	484686	463992	692499	0.950
2001	851253	314486	858619	1.016
2002	74343	327895	806921	0.785
2003	274977	402129	309724	0.710
2004	145349	173288	359362	0.790
2005	289127	152014	171790	0.732
2006	191141	155050	286751	0.563
2007	299138	313998	203392	0.426
2008	310412	389009	322738	0.547
2009		455164	336897	0.687
2010		456000**		

* landings do not include 0-group in the first half-year

** preliminary results at the end of the fishing season

6.4.22.1 A formula for 2010 in-year management of sandeel in the North Sea

In recent years, the European Union (EU) and Norway have used Real-Time Monitoring (RTM) of the fishery for sandeel in the North Sea to set the TAC within the fishing year. ICES (2009a, Section 6.4.2.4) recommended:

"…that fishing grounds that are known to be commercially depleted should be closed to fishing while at non-depleted fishing grounds fishing should only be allowed in 2010 if analysis of real-time monitoring indicates that the stock can be rebuilt to B_{pa} by 2011."

As an elaboration on the recommendation above, ICES offers the following advice on a formula for in-year management of the sandeel fishery in the North Sea:

$$TAC2010 = -333 + R1,2010 * 3.692$$

where R1,2010 is the stock size of age-1 sand eel in billions on 1 January 2010 and the TAC is in 1000 tonnes. The estimate R1,2010 is derived from the Cpue(age 1) obtained in the RTM fishery.

Background

A TAC based on the formula above is expected to result in an SSB equal to or greater than B_{pa} (estimated as 600 000 t) at the beginning of 2011 with a probability of 50%. The short term forecast presented by ICES (2009b) shows that assuming a low recruitment (25% percentile of the long term recruitment), the SSB at the beginning of 2011 is expected to reach B_{pa} with a catch of 150 000 in 2010. Such a catch might serve as a preliminary TAC to be used for the RTM period. As in previous years, an additional TAC-ceiling of 400 000t is suggested, based on the results from simulation studies (ICES, 2006).

The formula above differs from the formula used for in year management in previous years as follows:

The regression between the recruitment estimate and the Cpue (age 1) is based on catch per unit effort data from 1999 onward. The previous formula used data from earlier years. These data from early years were excluded from the derivation of the formula above because ICES (2009b) showed that there was a steep increase in vessel efficiency in 1999.

Biological samples used to calculate the size composition of the RTM catch (and therefore to infer the age composition) will be stratified by week and ICES statistical rectangle. This is necessary to account for the potential of oversampling inshore fishing trips of short duration. The potential of a bias from oversampling these trips was identified and dealt with in an ad hoc manner for the 2009 RTM. A more formal stratification procedure will be applied in 2010.

No adjustment is made for the mean weight of age 1 sandeel in the RTM fishery. In previous years, the formula included an adjustment for mean weight. The justification for the adjustment was that a higher mean weight requires fewer fish to be caught and that surviving sandeel contributes more to the SSB after the fishery. However, an analysis conducted by ICES (2009c) indicates that there is no relation between the observed mean weight at age in the RTM period and the mean weight at age in the total international catch.

ICES (2008) expressed concern about the relatively narrow spatial distribution of the sandeel fishery recent years, as this could reflect depletion of sandeel in areas which are no longer fished. ICES (2009c) gave an alternative interpretation. The implications of the narrow spatial distribution of the fishery in recent years are not addressed in the derivation of the formula recommended above.

Source of information

ICES. 2006. Report of the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak (WGNSSK). 5–14 September.ICES CM 2006/ACFM:35.

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