

6.4.9 Sole in Division IIIa (Skagerrak and Kattegat)

State of the stock

Spawning biomass in relation to precautionary limits	Fishing mortality in relation to precautionary limits	Fishing mortality in relation to high long-term yield	Fishing mortality in relation to agreed management target	Comment
Full reproductive capacity	Harvested sustainably	Appropriate	NA	

Based on the most recent estimates of SSB (in 2009) and F (in 2008), ICES classifies the stock as having full reproductive capacity and being harvested sustainably. SSB has decreased since 2005 but is still well above B_{pa} . Fishing mortality has increased from 0.22 in 2007 to 0.28 in 2008. Recruitment has been below average in recent 4 years.

Management objectives

There are no management objectives for this stock.

Reference points

	Type	Value	Technical basis
Precautionary approach	B_{lim}	770 t	$B_{pa} * \exp(-1.645 * 0.2)$
	B_{pa}	1060 t	MBAL
	F_{lim}	0.47	$F_{med} 98$ excluding the abnormal years around 1990
	F_{pa}	0.30	consistent with F_{lim}
Targets	F_v	not defined	

(unchanged since 1999)

Yield and spawning biomass per Recruit F-reference points:

	Fish Mort Ages 4-8	Yield/R	SSB/R
Average last 3 years	0.27	0.19	0.88
F_{max}^*			
$F_{0.1}$	0.17	0.17	1.19
F_{med}	0.38	0.20	0.68

* F_{max} not well defined

Candidates for reference points which are consistent with high long-term yields and a low risk of depleting the productive potential are in the range of $F_{0.1}$ to F_{pa} .

Single-stock exploitation boundaries

ICES advises on the basis of exploitation boundaries in relation to precautionary limits that fishing mortality in 2010 should be kept below F_{pa} , corresponding to landings of less than 620 t.

Short-term implications

Basis: $F(2009) = F_{sq} = \text{mean } F(06-08)$ rescaled to the last year = 0.28; $R94-06 = GM = 3.1$ million; $SSB(2009) = 2.4$; $SSB(2010) = 2.3$; landings (2009) = 0.57.

Rationale	Landings (2010)	Basis	F(2010)	SSB(2011)	%SSB change ¹	%TAC change ²
Zero catch	0	$F=0$	0	2.90	24%	-100%
<i>Status quo</i>	0.58	F_{sq}	0.28	2.31	-1%	-28%
Precautionary limits	0.07	$F_{pa} * 0.1$	0.03	2.83	21%	-91%
	0.17	$F_{pa} * 0.25$	0.08	2.73	16%	-79%
	0.33	$F_{pa} * 0.5$	0.15	2.57	9%	-59%
	0.58	$F_{pa} * 0.73 = F_{sq}$	0.28	2.31	-1%	-40%
	0.56	$F_{pa} * 0.9$	0.27	2.33	-1%	-30%
	0.62	$F_{pa} = F_{sq} * 1.08$	0.30	2.27	-3%	-23%
	0.67	$F_{pa} * 1.1$	0.33	2.22	-5%	-16%
	0.75	$F_{pa} * 1.25$	0.38	2.14	-9%	-6%
	0.87	$F_{pa} * 1.5$	0.45	2.02	-14%	9%
	0.99	$F_{pa} * 1.75$	0.53	1.90	-19%	23%

All weights in thousand tonnes.

Shaded scenarios are not considered consistent with the precautionary approach.

¹) SSB 2011 relative to SSB 2010.

²) Landings 2010 relative to TAC 2009.

Management considerations

The fishery for sole in the adjacent Belt Sea has increased in recent years with landings of about 15-20% of the landings in Kattegat and Skagerrak. The TAC applies to all of the Divisions IIIa, b, c, and d (i.e. the Skagerrak, the Kattegat, and both the Western and the Eastern Baltic) although the advice is based on the state of the stock in Division IIIa only. The stock structure must be investigated to determine to what extent sole in the Belt Sea belong to the same stock unit as sole in Kattegat/Skagerrak and consequently whether they should be managed together or separately.

During the period 2002–2004 there was considerable misreporting due to limiting TACs and weekly quota. Since mid-2005, the increase in TAC and improved control appears to have resulted in negligible misreporting.

Sole is taken in a directed trawl fishery with bycatch of *Nephrops* and cod. Cod in the Kattegat is considered to be severely depleted. Also, sole is taken as bycatch in the *Nephrops* trawl fishery. There is a directed gillnet fishery for sole.

Regulations and their effects

The Danish fishery has in the past been regulated by half-monthly quotas which depended on vessel length and varied over the year. From 2007 a vessel quota share system (VQS) was put in force, allowing fishers to trade quotas and to decide when to fish them. The VQS was fully implemented during late 2007. The logbook data do not indicate any effects of the VQS on seasonal/spatial effort distribution.

The management area includes Division IIIa plus the Western Baltic (Subdivisions 22–24). Danish vessel quota shares cover the management area and there is therefore no incentive to misreport sole taken in Division IIIa into the Western Baltic.

Factors affecting the fisheries and the stock

Changes in fishing technology and fishing patterns

There are no major changes in the sole-directed fishery in recent years. Changes in the regulations for the *Nephrops* fishery, with the introduction of a sorting grid system in the trawls, may have resulted in smaller bycatch and improved selectivity on sole. Since 1 February 2008 exit square mesh panels have been mandatory in the trawl fishery to prevent by-catches of cod. This device is not expected to influence the sole catches.

Impact of the environment on the fish stock

The stock is probably influenced by both temperature and salinity because it is located near the species' physiological limits for both of these factors.

Scientific basis

Data and methods

The analytical XSA assessment includes cpue data from three commercial tuning series (reference fleets) and one scientific survey series.

Discarding is not assumed to occur to any extent of importance to the assessment and is not included.

During the period 2002–2004 there was considerable misreporting due to limiting TACs and weekly quota which were included in the assessment. Since mid-2005, the increase in TAC and improved control are believed to have resulted in insignificant misreporting.

Information from the fishing industry

Collaboration between the Danish Fishers' Organization and DTU Aqua was initiated in 2004 to establish a database with data from private logbooks. Haul-specific data from six trawlers and three gillnetters covering the time period 1987 to 2008 were used in the assessment. However, the gillnetter information was not available in 2008.

Uncertainties in assessment and forecast

The assessment is considered uncertain; in recent years there is a tendency to overestimate SSB. There is a need for fishery-independent data as the current survey does not target sole. A sole-directed research survey was initiated in 2004, and the time-series of catch rates will be considered in 2010 when it is sufficiently long and when the survey has been evaluated as an abundance index.

If the share of catches in the Belt Sea remains important and if the population, in that area belongs to the IIIa stock the basis for the assessment and advice should include catches from the Belt Sea.

Comparison with previous assessment and advice

The present assessment has revised the perception of the recent levels of SSB and F as SSB in 2008 has been overestimated by 30%, while estimates of F in 2007 has been underestimated by 5%. (Figure 6.4.9.3). The basis for present advice is the same as last year.

Source of information

Report of the Baltic Fisheries Assessment Working Group. Copenhagen, 22-28 April 2009 (ICES CM 2009/ACOM:06).

Table 6.4.9.1 Sole in Division IIIa. Single stock exploitation boundaries (advice), management and landings.

Year	ICES Advice	Single-stock exploitation boundaries	Predicted catch corresp. to advice	Predicted catch corresp. to single-stock exploitation boundaries	Agreed TAC ²	ICES Landings
1987	-		-		0.85	0.72
1988	-		-		0.95	0.71
1989	TAC		<0.8		0.80	0.82
1990	Precautionary TAC		0.6		0.50	1.05
1991	TAC		1.0		1.00	- ¹
1992	TAC		1.0		1.40	- ¹
1993	TAC at recent catch levels		1.0		1.60	- ¹
1994	No advice due to uncertain catches		-		2.10	1.20
1995	No advice		-		2.25	1.30
1996	No advice		-		2.25	1.10
1997	No advice		-		2.25	0.81
1998	No advice		-		1.80	0.61
1999	No increase in F		0.8		1.35	0.64
2000	No increase in F		0.65		0.95	0.63
2001	No increase in F		0.7		0.70	0.46
2002	F below F_{pa}		0.5		0.50	0.84
2003	F below F_{pa}		0.3		0.35	0.60
2004	F below F_{pa}		0.5		0.52	0.78
2005	No increase in F		0.85		0.90	0.82
2006	F below F_{pa}		0.82		0.90	0.73
2007	Limit catches to 2002–2005 average		0.74		0.90	0.54
2008	keep F below F_{pa}		0.97		0.94	0.54
2009	keep F below F_{pa}		0.80		0.80	
2010	keep F below F_{pa}		0.62			

Weights in '000 t.

¹⁾Uncertain.

²⁾TAC applies to Division IIIa and the EC waters of Divisions IIIb and IIIc, d.

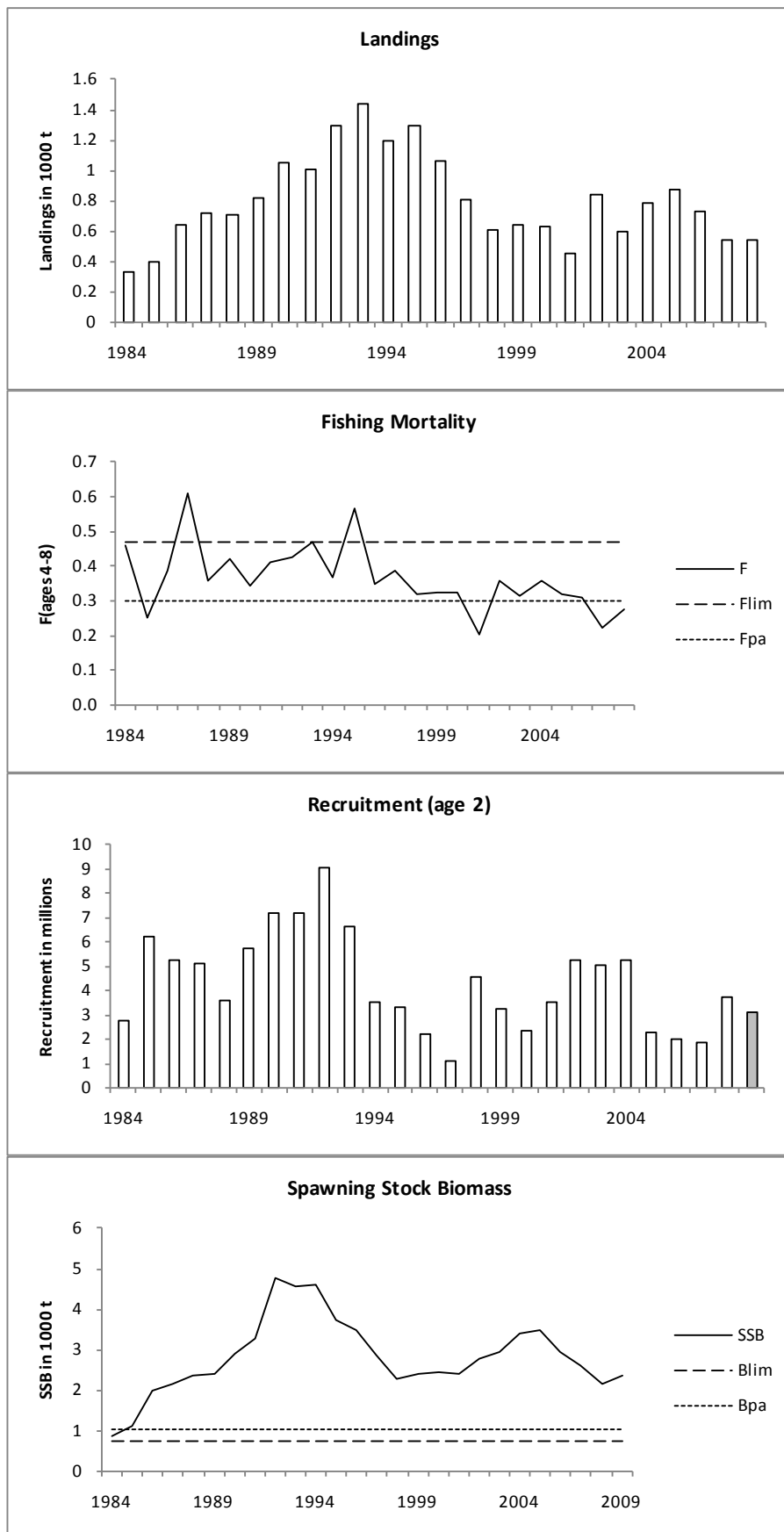


Figure 6.4.9.1 Sole in Division IIIa. Landings, fishing mortality, recruitment, and SSB. Predicted values are shaded.

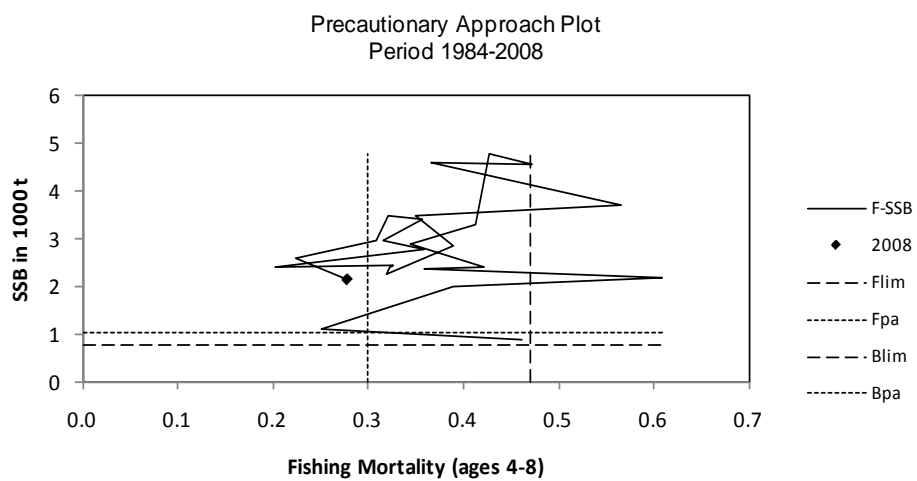
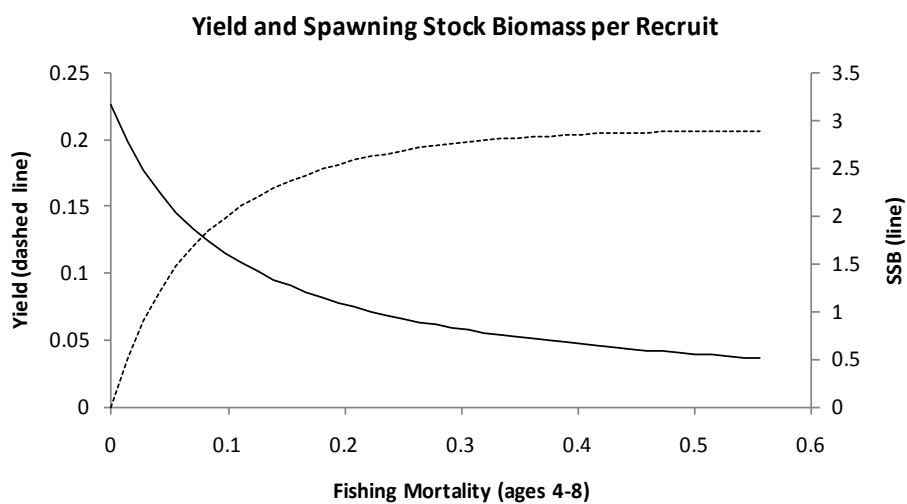
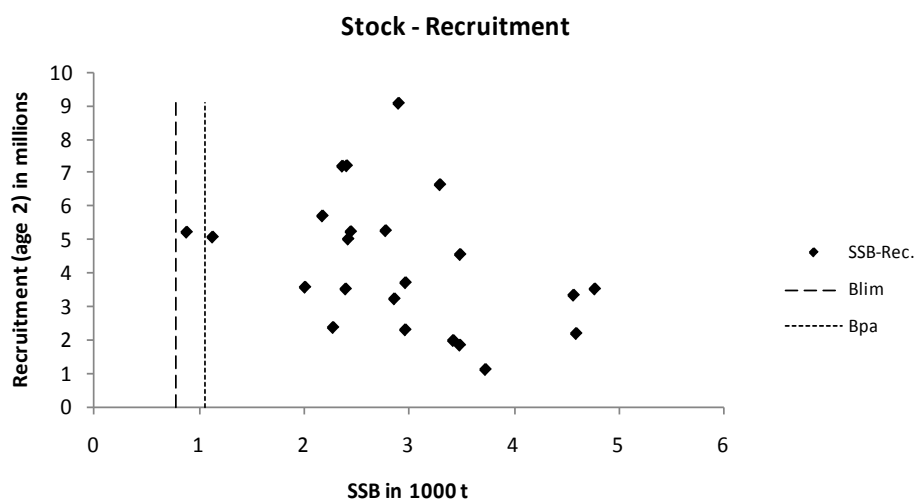


Figure 6.4.9.2 Sole in Division IIIa. Stock recruitment, yield, and precautionary approach.

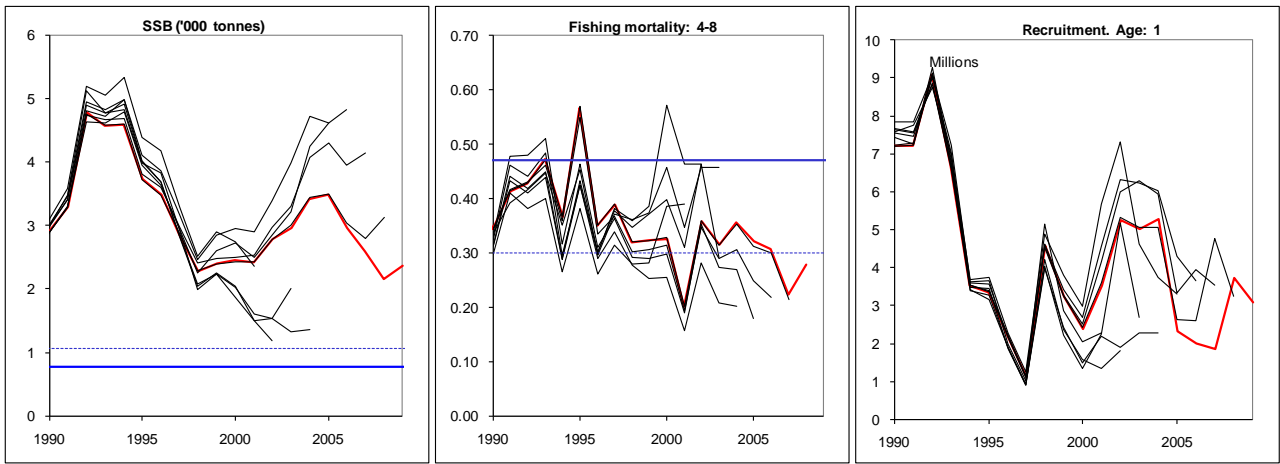


Figure 6.4.9.3 Sole in Division IIIa. Historical performance of the assessments. Note: some of the earlier assessments were considered valid for trends only.

Table 6.4.9.2 Sole in Division IIIa. Catches (tonnes) in the Kattegat and Skagerrak 1952–2008. Official statistics and Working Group corrections. For Sweden there is no information 1962–1974.

Year	Denmark		Sweden	Germany	Belgium	Netherlands	Working Group Corrections	Total
	Kattegat	Skagerrak	Skag+Kat	Kat+Skag	Skagerrak	Skagerrak		
1952	156		51	59				266
1953	159		48	42				249
1954	177		43	34				254
1955	152		36	35				223
1956	168		30	57				255
1957	265		29	53				347
1958	226		35	56				317
1959	222		30	44				296
1960	294		24	83				401
1961	339		30	61				430
1962	356			58				414
1963	338			27				365
1964	376			45				421
1965	324			50				374
1966	312			20				332
1967	429			26				455
1968	290			16				306
1969	261			7				268
1970	158	25						183
1971	242	32		9				283
1972	327	31		12				370
1973	260	52		13				325
1974	388	39		9				436
1975	381	55	16	16		9	-9	468
1976	367	34	11	21	2	155	-155	435
1977	400	91	13	8	1	276	-276	513
1978	336	141	9	9		141	-141	495
1979	301	57	8	6	1	84	-84	373
1980	228	73	9	12	2	5	-5	324
1981	199	59	7	16	1			282
1982	147	52	4	8	1	1	-1	212
1983	180	70	11	15		31	-31	276
1984	235	76	13	13		54	-54	337
1985	275	102	19	1	+	132	-132	397
1986	456	158	26	1	2	109	-109	643
1987	564	137	19		2	70	-70	722
1988	540	138	24		4			706
1989	578	217	21	7	1			824
1990	464	128	29	-	2		+427	1050
1991	746	216	38	+			+11	1011 ¹
1992	856	372	54				+12	1294 ¹
1993	1016	355	68	9			-9	1439 ¹
1994	890	296	12	4			-4	1198
1995	850	382	65	6			-6	1297
1996	784	203	57	612			-597	1059
1997	560	200	52	2				814
1998	367	145	90	3				605
1999	431	158	45	3				637
2000	399	320	34	11			-132 ²	633 ²
2001 ¹	249	286	25				-103 ²	455 ²
2002	360	177	15	11			+281 ³	844
2003	195	77	11	17			+301 ³	602
2004	249	109	16	18			+392 ³	784
2005	531	132	30	34	Norway		+145 ³	727
2006	521	114	38	43	9	4		729
2007	366	81	45	39	9			541
2008	361	102	34	35	7	3		544

¹ Considerable non-reporting assumed for the period 1991–1993.

² Catches from Skagerrak were reduced by these amounts because of misreporting from the North Sea. The subtracted amount has been added to the North Sea sole catches. Total landings for these years in IIIA has been reduced by the amount of misreporting.

³ Assuming misreporting rates at 50, 100, 100, and 20% in 2002-2005, respectively.

Table 6.4.9.3

Sole in Division IIIa. Summary of the assessment.

Year	Recruitment Age 1 thousands	SSB tonnes	Landings tonnes	Mean F Ages 4-8
1984	2756	884	337	0.4618
1985	6259	1131	397	0.2509
1986	5238	2011	643	0.3895
1987	5092	2177	722	0.6081
1988	3593	2367	706	0.3585
1989	5724	2408	824	0.4224
1990	7212	2902	1050	0.3449
1991	7224	3296	1011	0.4135
1992	9092	4770	1294	0.4268
1993	6659	4568	1439	0.4717
1994	3541	4593	1198	0.3663
1995	3355	3729	1297	0.5664
1996	2209	3488	1059	0.3497
1997	1133	2862	814	0.3886
1998	4571	2278	605	0.3194
1999	3246	2398	638	0.3228
2000	2389	2447	633	0.3257
2001	3540	2422	455	0.2016
2002	5252	2779	845	0.3583
2003	5033	2966	600	0.3148
2004	5283	3422	782	0.3567
2005	2320	3485	878	0.3206
2006	2000	2968	729	0.3079
2007	1861	2598	542	0.2243
2008	3728	2151	543	0.2779
2009	3098*	2370		
Average	4285	2826	802	0.3660

* Recruitment in 2009 is Geometric Mean (1994-2006).