6.3.46 Sole (*Solea solea*) in Division 3.a and subdivisions 22–24 (Skagerrak and Kattegat, western Baltic Sea)

ICES stock advice

ICES advises that when the MSY approach is applied, catches in 2017 should be no more than 555 tonnes.

Stock development over time

Spawning-stock biomass (SSB) has been fluctuating between MSY $B_{trigger}$ and B_{lim} since 2008 and is estimated to be below MSY $B_{trigger}$ in 2016. Fishing mortality (F) has decreased since 2005 and has been below F_{MSY} since 2010. After a series of low recruitment years the 2013 and 2014 year classes are estimated to be above recent average.

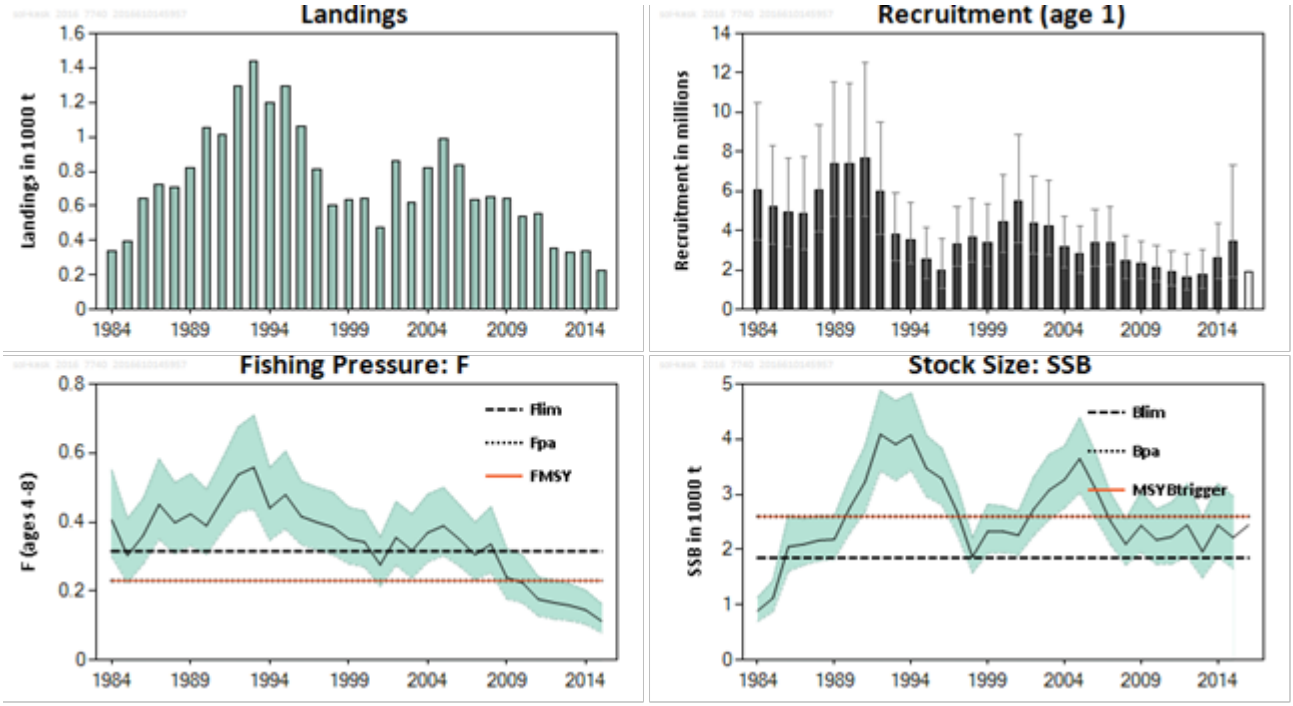

Figure 6.3.46.1 Sole in Division 3.a and subdivisions 22–24. Summary of stock assessment (weights in tonnes). 95% confidence limits indicated for recruitment, fishing mortality, and spawning-stock biomass. Predicted values are not shadowed.

Stock and exploitation status

Table 6.3.46.1 Sole in Division 3.a and subdivisions 22–24. State of the stock and fishery relative to reference points.

		Fishing pressure					Stock size				
		2013	2014	2015			2014	2015	2016		
Maximum sustainable yield	F_{MSY}	✓	✓	✓	Appropriate		MSY $B_{trigger}$	✗	✗	✗	Below trigger
Precautionary approach	F_{pa}, F_{lim}	✓	✓	✓	Harvested sustainably		B_{pa}, B_{lim}	o	o	o	Increased risk
Management plan	F_{MGT}	-	-	-	Not applicable		SSB_{MGT}	-	-	-	Not applicable

https://doi.org/10.17895/ices.advice.18667994

Catch options

Table 6.3.46.2 Sole in Division 3.a and subdivisions 22–24. The basis for the catch options.

Variable	Value	Source	Notes
F ages 4–8 (2016)	0.23	ICES (2016a)	F corresponding to TAC constraint of landings of 391 t in 2016. F corresponds only to landings.
SSB (2017)	2795 t	ICES (2016a)	Short term forecast.
R_{age1} (2016–2017)	1915 thousands	ICES (2016a)	Sampling from recent low recruitment (2011–2015).
Total catch (2016)	407 t	ICES (2016a)	Assumed landings (quota in 2016) plus discards.
Landings (2016)	391 t	ICES (2016a)	Assessment not including discards, topping up in advice.
Discards (2016)	4%	ICES (2016a)	Mean (2011–2015). Discard rate in weight.

Table 6.3.46.3 Sole in Division 3.a and Subdivisions 22–24. The catch options. Weights in tonnes.

Rationale	Total catch (2017)*	Wanted catch (2017)**	Basis	F wanted catch (2017)	SSB (2018)	%SSB change ***	%TAC change wanted catch^
MSY approach	555	534	FMSY	0.23	2749	-2	37
Precautionary approach	555	534	Fpa	0.23	2749	-2	37
Zero catch	0	0	F = 0		3310	18	-100
Other options	238	229	F2016 × 0.5	0.09	3072	10	-41
	555	534	Fsq (F2016)	0.23	2749	-2	37
	347	334	−15% TAC (F2016 × 0.7)	0.14	2955	6	-15
	412	396	No change TAC (F2016 × 0.9)	0.17	2893	3	1
	467	449	+15% TAC (F2016 × 1.0)	0.19	2834	1	15
	706	679	SSB_{2018} = MSY $B_{trigger}$	0.30	2600	-7	74
	706	679	SSB_{2018} = Bpa	0.30	2600	-7	74
	1440	1385	SSB_{2018} = B_{lim}	0.74	1850	-34	254
	732	704	Flim (Fsq x 1.4)	0.31	2573	-8	80

* Total catch is calculated based on wanted catch (fish that would be landed in the absence of the EU landing obligation) and 4% discard rate (in weight).
** The "wanted catch" is used to describe fish that would be landed in the absence of the EU landing obligation.
*** SSB 2018 relative to SSB 2017.
^ Wanted catch 2017 relative to TAC 2016.

Basis of the advice

Table 6.3.46.4 Sole in Division 3.a and subdivisions 22–24. The basis of the advice.

Advice basis	MSY approach.
Management plan	There is no management plan for sole in this area.

Quality of the assessment

This stock has gone through an inter-benchmark process in the autumn of 2015 (ICES, 2015). This has changed the perception of the stock.

Sufficient biological sampling of landings is difficult to obtain due to the low total landings, which are dispersed spatially. With the record low landings in 2015, this affects the quality of the input data, including the weight-at-age.

Discard rates in recent years are low and vary around 4% in weight. They are not included in the assessment. Discarding in 2015 decreased to 2% in weight.

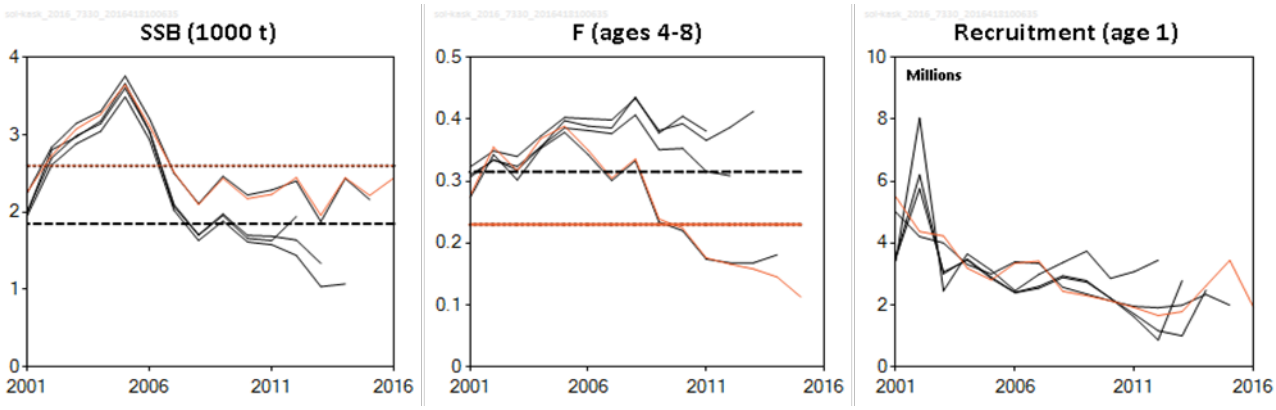

Figure 6.3.46.2 Sole in Division 3.a and subdivisions 22–24. Historical assessment results (final-year recruitment estimates included). Recruitment age in the assessment has changed from two to one following the inter-benchmark in 2015 (ICES, 2015).

Issues relevant for the advice

After the inter-benchmark in late 2015, new reference points were defined (ICES, 2015) and adopted for the stock. The changes in reference points in combination with a revised assessment and a new perception of the stock changed the stock status and the catch advice for the stock.

Reference points

Table 6.3.46.5 Sole in Division 3.a and dubdivisions 22–24. Reference points, values, and their technical basis.

Framework	Reference point	Value	Technical basis	Source
MSY approach	MSY $B_{trigger}$	2600 t	B_{pa}	ICES (2015)
	F_{MSY}	0.23	Equilibrium scenarios stochastic recruitment, short time-series 1992–2014, constrained by F_{pa}.	ICES (2015)
Precautionary approach	B_{lim}	1850 t	B_{loss} from 1992 (low productivity regime)	ICES (2015)
	B_{pa}	2600 t	$B_{lim} \times e^{1.645\sigma}$, $\sigma = 0.20$	ICES (2015)
	F_{lim}	0.315	Equilibrium scenarios prob (SSB< B_{lim})< 50% with stochastic recruitment	ICES (2015)
	F_{pa}	0.23	$F_{lim} \times e^{-1.645\sigma}$, $\sigma = 0.18$	ICES (2015)
Management plan	SSB_{MGT}	Not defined.		
	F_{MGT}	Not defined.		

Basis of the assessment

Table 6.3.46.6 Sole in Division 3.a and subdivisions 22–24. The basis of the assessment.

ICES stock data category	1 (ICES, 2016b)
Assessment type	Age-based analytical stochastic assessment (SAM) that uses landings only in the model. Discards are included afterwards in the forecast (ICES, 2016a).
Input data	Commercial catches (international landings, ages and length frequencies from catch sampling), one survey index (Fishermen–DTU Aqua 2004–2015), two commercial indices: (private logbook gillnetters (1994–2007), private logbook trawlers (1987–2008)); fixed maturity and fixed natural mortality (0.1) for all age groups.
Discards and bycatch	Used to provide advice, but not included in the assessment. Discard information available since 2000, average discard rates 2011–2015 from main fleets are 4%.
Indicators	None
Other information	Stock inter-benchmarked in 2015 (ICES, 2015).
Working group	Baltic Fisheries Assessment Working Group (WGBFAS)

Information from stakeholders

The cumulative index of perceptions of the abundance of common sole (Figure 6.3.46.3) increased until the mid-2000s and has remained somewhat stable since. This is in general agreement with ICES perception of the stock (Napier, 2014). No new information has been provided for 2015.

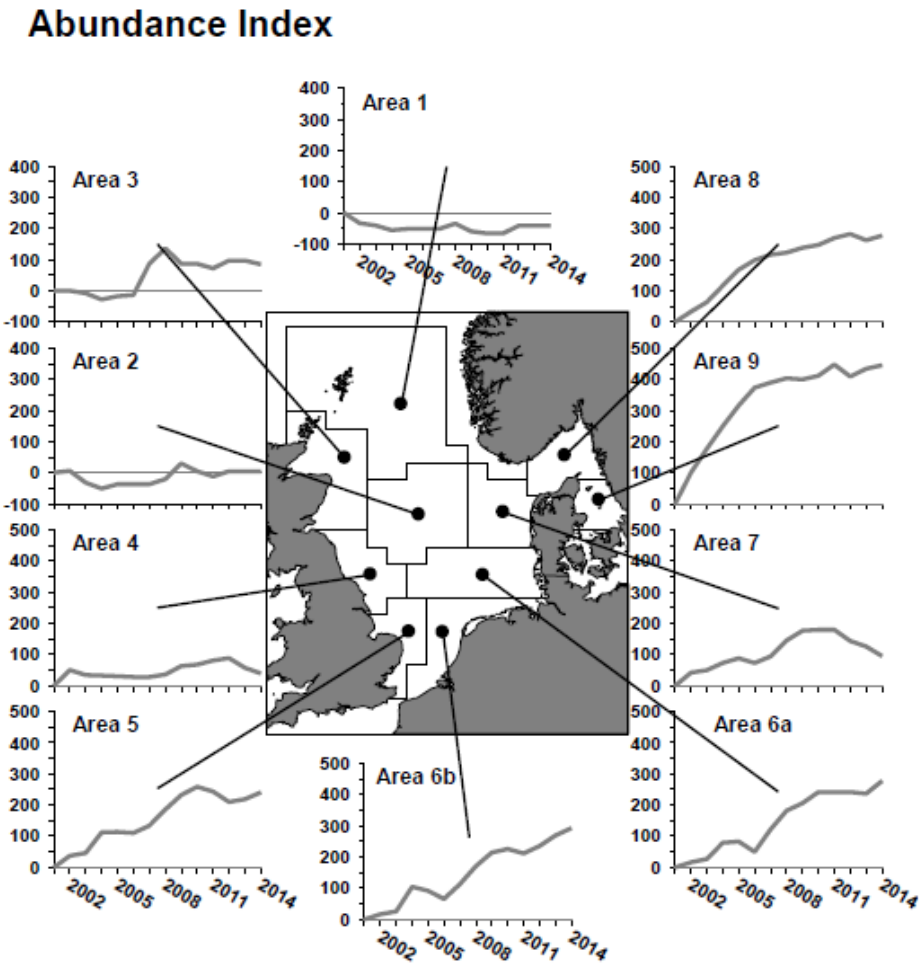

Figure 6.3.46.3 Cumulative time-series of index of perceptions of abundance of sole by roundfish sampling area from the Fishers' North Sea Stock Survey (Napier (2014); see page 14 for explanation of the index).

History of advice, catch, and management

Table 6.3.46.7 Sole in Division 3.a and subdivisions 22–24. History of ICES advice, the agreed TAC, and ICES estimates of landings. Weights in thousand tonnes.

Year	ICES advice	Predicted catch corresp. to advice	Predicted landings corresp. to advice	Agreed TAC*	ICES landings**	ICES discards***
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	-^	-
1992	TAC	-	1.0	1.40	-^	-
1993	TAC at recent catch levels	-	1.0	1.60	-^	-
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	0.65	0.169
2001	No increase in F	-	0.7	0.70	0.48	-
2002	F below F_{pa}	-	0.5	0.50	0.86	0.010
2003	F below F_{pa}	-	0.3	0.35	0.62	0.043
2004	F below F_{pa}	-	0.5	0.52	0.82	-
2005	No increase in F	-	0.85	0.90	0.99	-
2006	F below F_{pa}	-	0.82	0.90	0.84	-
2007	Limit catches to 2002–2005 average	-	0.74	0.90	0.63	-
2008	F below F_{pa}	-	0.97	0.94	0.66	-
2009	F below F_{pa}	-	0.80	0.80	0.64	-
2010	F below F_{pa}	-	0.62	0.70	0.54	0.014
2011	See scenarios	-	-	0.84	0.55	0.008
2012	MSY framework	-	0.61	0.61^^	0.36	0.011
2013	MSY framework	-	0.56	0.59	0.33	0.010
2014	MSY approach	0.353	0.353^^^	0.35	0.34	0.032
2015	MSY approach	0.211	0.205	0.205	0.224	0.006
2016	MSY approach	≤ 0.394	0.379	391		
2017	MSY approach	≤ 0.555	-			

*TAC applies to Division 3.a and the EC waters of Divisions 3.b and 3.c, d.

**Landings include Division 3.a and Subdivisions 22–24.

***Discard estimates are not available for all years.

^ Uncertain.

^^ No more than 461 t in Division 3.a.

^^^ Discarding assumed to be negligible.

History of catch and landings

Table 6.3.46.8 Sole in Division 3.a and subdivisions 22–24. Catch distribution by fleet in 2015 as estimated by ICES.

Total catch (2015)	Official landings		Discards
230 t	64 % demersal trawl	36 % gillnets	6 t
	224 t		

Table 6.3.46.9 Sole in Division 3.a and subdivisions 22–24. History of commercial landings by country and area. Weights in tonnes.

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak+ Kattegat	Kattegat+ Belts	Skagerrak	Skagerrak	Skagerrak		
1952	156			51	59				266	266
1953	159			48	42				249	249
1954	177			43	34				254	254
1955	152			36	35				223	223
1956	168			30	57				255	255
1957	265			29	53				347	347
1958	226			35	56				317	317
1959	222			30	44				296	296
1960	294			24	83				401	401
1961	339			30	61				430	430
1962	356				58				414	414
1963	338				27				365	365
1964	376				45				421	421
1965	324				50				374	374
1966	312				20				332	332
1967	429				26				455	455
1968	290				16				306	306
1969	261				7				268	268
1970	158	25							183	183
1971	242	32			9				283	283
1972	327	31			12				370	370
1973	260	52			13				325	325
1974	388	39			9				436	436
1975	381	55		16	16		9		477	468
1976	367	34		11	21	2	155		590	435
1977	400	91		13	8	1	276		789	513
1978	336	141		9	9		141		636	495
1979	301	57		8	6	1	84		457	373
1980	228	73		9	12	2	5		329	324
1981	199	59		7	16	1			282	282
1982	147	52		4	8	1	1		213	212
1983	180	70		11	15		31		307	276
1984	235	76		13	13		54		391	337
1985	275	102		19	1	+	132		529	397
1986	456	158		26	1	2	109		752	643
1987	564	137		19		2	70		792	722
1988	540	138		24		4			706	706
1989	578	217		21	7	1			824	824
1990	464	128		29		2			623	1050
1991*	746	216		38	+				1000	1011
1992	856	372		54					1282	1294

Year	Denmark			Sweden	Germany	Belgium	Netherlands	Norway	Total official landings	ICES estimated landings
	Kattegat	Skagerrak	Belts	Skagerrak+ Kattegat	Kattegat+ Belts	Skagerrak	Skagerrak	Skagerrak		
1993	1016	355		68	9				1448	1439
1994	890	296		12	4				1202	1198
1995	850	382		65	6				1303	1297
1996	784	203		57	612				1656	1059
1997	560	200		52	2				814	814
1998	367	145		90	3				605	605
1999	431	158		45	3				637	637
2000	399	320	13	34	11				777	645
2001	249	286	21	25					581	478
2002**	360	177	18	15	11				581	862
2003**	195	77	17	11	17				317	618
2004**	249	109	40	16	18				432	824
2005**	531	132	118	30	34				845	990
2006	521	114	107	38	43		4	9	836	836
2007	366	81	93	45	39		0	9	633	633
2008	361	102	113	34	35		3	7	655	655
2009	325	103	145	37	27			4	641	641
2010	273	61	125	46	26		3	3	537	538
2011	271	127	65	53	33			3	552	552
2012	154	140	28	30				6	358	358
2013	153	78		54	9			6	300	332
2014	141	104	48	36	2		0.3	3	335	335
2015	95	66	36	9	7		6	5	224	224

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

**Assuming misreporting rates at 50%, 100%, 100%, and 20% in 2002–2005, respectively.

Summary of the assessment

Table 6.3.46.10 Sole in Division 3.a and subdivisions 22–24. Assessment summary with weights in tonnes. Recruitment in thousands.

Year	Recruitment (Age 1)	High	Low	Stock Size: SSB	High	Low	Landings	Fishing Pressure: F (Ages 4-8)	High	Low
1984	6071	10455	3525	891	1133	701	337	0.406	0.55	0.3
1985	5223	8298	3287	1122	1439	874	397	0.303	0.41	0.224
1986	4937	7693	3168	2052	2620	1607	643	0.361	0.468	0.278
1987	4848	7749	3034	2095	2553	1719	722	0.451	0.582	0.35
1988	6069	9385	3925	2167	2615	1795	706	0.398	0.514	0.308
1989	7380	11564	4710	2184	2607	1829	824	0.423	0.54	0.331
1990	7372	11481	4734	2755	3300	2299	1050	0.389	0.494	0.306
1991	7676	12508	4710	3225	3877	2683	1011	0.465	0.582	0.372
1992	6017	9480	3819	4088	4876	3428	1294	0.537	0.675	0.428
1993	3803	5919	2444	3907	4696	3250	1439	0.558	0.709	0.438
1994	3522	5403	2296	4076	4834	3436	1198	0.44	0.557	0.347
1995	2557	4123	1586	3471	4069	2961	1297	0.479	0.605	0.38
1996	1954	3579	1067	3284	3836	2811	1059	0.416	0.518	0.334
1997	3343	5192	2153	2688	3159	2288	814	0.399	0.5	0.319
1998	3648	5623	2366	1866	2207	1579	605	0.385	0.486	0.305
1999	3416	5352	2180	2332	2819	1929	637	0.351	0.442	0.279
2000	4410	6800	2860	2329	2785	1947	645	0.342	0.432	0.27
2001	5497	8889	3399	2260	2690	1898	478	0.276	0.356	0.214
2002	4374	6746	2836	2735	3315	2257	862	0.355	0.459	0.275
2003	4231	6574	2724	3076	3724	2541	618	0.317	0.423	0.237
2004	3191	4744	2146	3265	3872	2753	824	0.369	0.48	0.284
2005	2807	4241	1858	3648	4387	3032	990	0.389	0.5	0.302
2006	3350	5064	2216	3112	3766	2571	836	0.35	0.45	0.273
2007	3416	5218	2237	2516	3020	2096	633	0.305	0.399	0.233
2008	2444	3760	1588	2098	2555	1722	655	0.336	0.444	0.253
2009	2300	3468	1525	2436	3041	1952	641	0.239	0.322	0.177
2010	2134	3219	1415	2175	2732	1731	538	0.224	0.304	0.166
2011	1915	2966	1237	2231	2859	1741	552	0.176	0.24	0.128
2012	1659	2809	980	2447	3196	1873	358	0.166	0.231	0.119
2013	1783	3010	1056	1958	2578	1487	332	0.158	0.22	0.114
2014	2613	4383	1558	2445	3194	1872	335	0.145	0.202	0.104
2015	3443	7310	1622	2217	2967	1656	224	0.113	0.163	0.079
2016	1915*			2445**						
Average	**3919**	**6344**	**2508**	**2594**	**3166**	**2135**	**737**	**0.344**	**0.446**	**0.266**

*estimated from the period 2011–2015
** forward projected from 2015

Sources and references

ICES. 2015. Report of the Inter-Benchmark Workshop on Sole in Division IIIa and Subdivisions 22–24 (Skagerrak and Kattegat, Western Baltic Sea), 1 July–31 October 2015, By correspondence. ICES CM 2015/ACOM:57. 36 pp.

ICES. 2016a. Report of the Baltic Fisheries Assessment Working Group (WGBFAS), 12–19 April 2016, ICES Headquarters, Copenhagen, Denmark. ICES CM 2016/ACOM:11.

ICES. 2016b. General context of ICES advice. *In* Report of the ICES Advisory Committee, 2016. ICES Advice 2016, Book 1, Section 1.2.

Napier, I. R. 2014. Fishers' North Sea stock survey 2014. NAFC Marine Centre, Shetland, Scotland. http://nsss.eu.