

5.2 Pelagic fish abundance and distribution

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Number of fish sampled during the survey is presented in Appendix 2.

5.2.1 Capelin (*Mallotus villosus*)

Distribution

The geographical density distribution of capelin of age group 1 and total stock are shown in Figures 5.2.1.1 and 5.2.1.2. The distribution area of capelin in the area which was covered was similar to that found in 2008-2011 and 2013, with high concentrations close to the coast east of Svalbard/Spitsbergen archipelago, and to the south-west of Frans Josef Land. Hardly any capelin were detected in the areas to the west of the Svalbard/Spitsbergen archipelago. Young capelin were mainly found to the south of 78°N, and the total distribution area of young capelin was lower than in previous years, in particular in the eastern Barents Sea.

The area in between Svalbard/Spitsbergen archipelago and Frans Josef Land north of 78° was not accessible due to extensive broken ice cover. Both young and adult capelin were distributed here in 2013, and adult capelin regionally in high concentrations. There was also not enough available ship time to cover the area east of 60 degrees east. Adult capelin was found here in 2013.

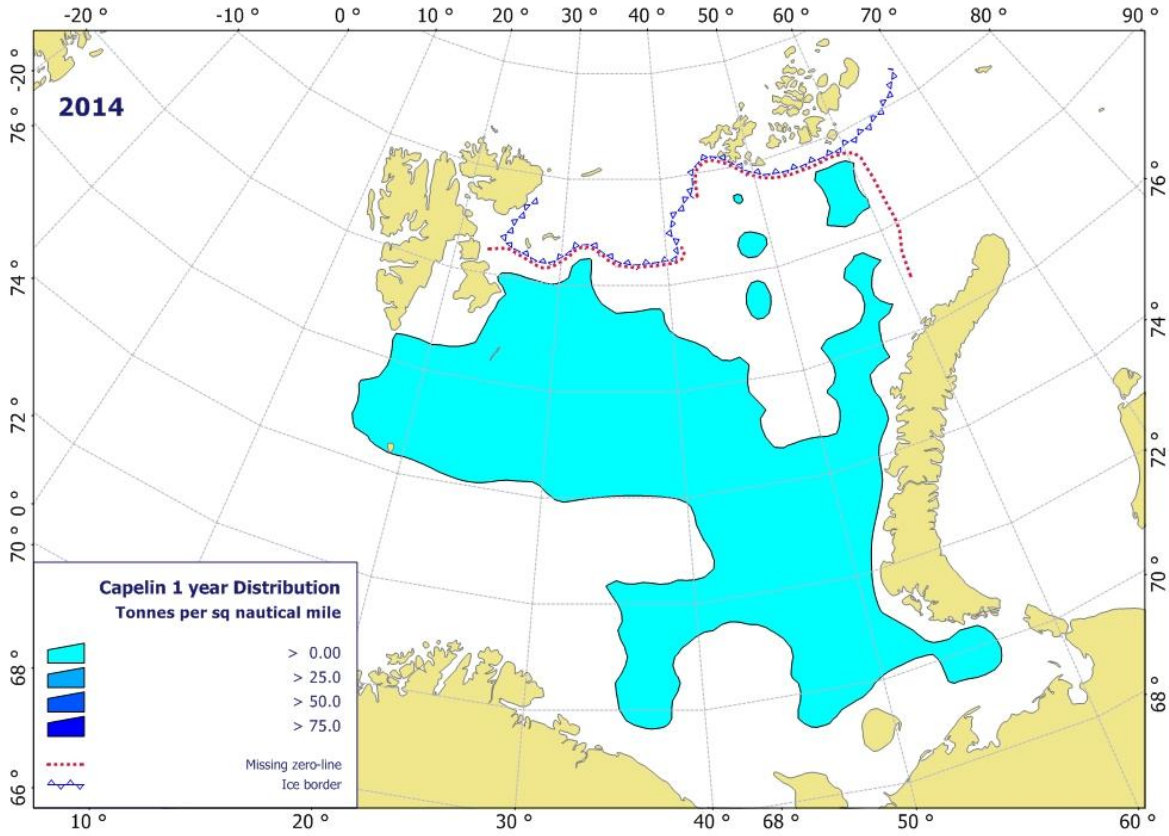


Figure 5.2.1.1 Estimated density distribution of 1-year-old capelin (t/sq nautical mile), August-October 2014

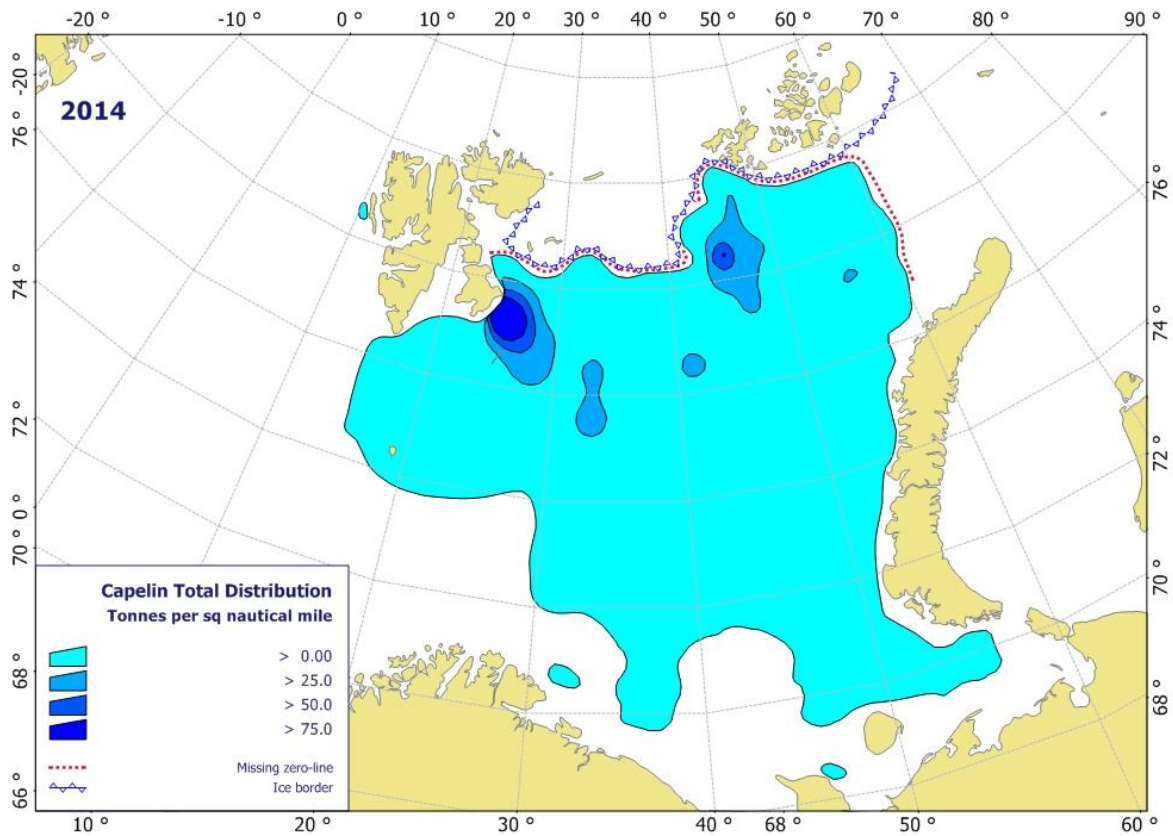


Figure 5.2.1.2 Estimated total density distribution of capelin (t/sq nautical mile), August-October 2014

Abundance estimate and size by age

A detailed stock size estimate is given in Table 5.2.1.1, and the time series of abundance estimates is summarized in Table 5.2.1.2. Note that the estimates for 2014 are not corrected for the reduced area coverage, but corrections were added for the input to the stock assessment and prognosis model for capelin (CapTool). The mature part of the stock is basis for the prognosis of spawning stock in spring 2015, where also mortality induced by predation enters into the calculations. The work concerning assessment and quota advice for capelin is dealt with in a separate report that will form part of the ICES Arctic Fisheries Working Group report for 2015.

The main results of the abundance estimation in 2014 are summarized in Table 5.2.1.3. The 2013 estimate is shown on a shaded background for comparison. The total stock is estimated at about 2 million tonnes, which is only about 50% of the stock size estimated for 2013, and lower than the long term mean level (about 3 million tonnes, Table 5.2.1.2). About 44 % (0.8 million tonnes) of this stock has length above 14 cm and is considered to be maturing. Again, these values are not compensated for reduced survey coverage, and in the management advice, the abundance is corrected based on the 2011-2013 capelin distribution in the uncovered area (See ICES Arctic Fisheries Working Group report for 2015).

The 2013 year class (1-year group) consists, according to this estimate, of about 105 billion individuals. This estimate is lower than the long-term average. The mean weight (3 g) is 0.2 g lower than that measured last year and somewhat below the long-term average. The biomass of the 2013 year class is about 0.32 million tonnes, which is the lowest since the 2006 year class, and >50% below the long term mean. It should be kept in mind that, given the limitations of the acoustic method concerning mixed concentrations of small capelin and 0-group fish and near-surface distribution, the 1-year group estimate might be more uncertain than that for older capelin.

The estimated number for the 2012 year class (2-year group) is about 107 billion, which is >50 % of the size of the 2011 year class measured in 2013. The mean weight of this group in 2014 is 9 g. This mean weight is higher than in 2013 (8.4 g), but ca. 1.5 grams below the long-term average (Table 5.2.1.2). The biomass of the 2-year group is about 1 million tonnes in 2014; a value which is below the long term average and the lowest since 2007.

The 2011 year class is estimated at about 39 billion individuals; a figure that is 35% lower than the estimated size of three-year-olds in 2013. This age group with mean weight 16.3 g (about 3.2 g below the long-term average) has a biomass of about 0.64 million tonnes, which is a little below the long-term average. The 2010 year class (now 4 years old) is estimated at about 2 billion individuals. With a mean weight of 20.3 g, this age group makes up about 40 thousand tonnes, about 25% of the estimate of this age group last year, and well below the long term average. Practically no capelin older than four years was found.

Table 5.2.1.1 Barents Sea capelin. Acoustic estimate in August-October 2014. The figures are not compensated for incomplete survey coverage

Length (cm)	Age/Year class				Sum	Biomass	Mean weight (g)
	1	2	3	4			
	2013	2012	2011	2010	(10 ⁹)	(10 ³ t)	
6-6.5	0.486	0	0	0	0.486	0.3	0.7
6.5-7	4.655	0	0	0	4.655	4.7	1
7-7.5	9.225	0	0	0	9.225	10.3	1.1
7.5-8	7.575	0.503	0	0	8.078	11.6	1.4
8-8.5	9.533	0	0	0	9.533	19.1	2
8.5-9	11.729	0	0	0	11.729	27.8	2.4
9-9.5	15.154	0.448	0	0	15.602	45.2	2.9
9.5-10	15.827	0.668	0	0	16.494	56.3	3.4
10-10.5	16.242	1.533	0	0	17.775	70.9	4
10.5-11	8.49	4.832	0	0	13.321	62.9	4.7
11-11.5	2.951	10.349	0.165	0	13.466	74.9	5.6
11.5-12	1.883	13.922	0.098	0	15.904	101.3	6.4
12-12.5	0.572	16.284	0.369	0	17.225	127.9	7.4
12.5-13	0.4	16.437	1.366	0	18.204	155.4	8.5
13-13.5	0.258	15.073	1.82	0	17.151	165.6	9.7
13.5-14	0.087	9.215	3.455	0	12.757	141.2	11.1
14-14.5	0	6.906	3.974	0.157	11.038	138.1	12.5
14.5-15	0	4.872	6.848	0.092	11.812	171.2	14.5
15-15.5	0.084	1.898	5.135	0.316	7.432	119.6	16.1
15.5-16	0	1.765	7.294	0.264	9.323	171	18.3
16-16.5	0	0.97	3.521	0.501	4.992	103	20.6
16.5-17	0	0.224	3.056	0.3	3.58	83.6	23.4
17-17.5	0	0.446	1.366	0.143	1.955	51.6	26.4
17.5-18	0	0.204	0.712	0.117	1.033	29.2	28.2
18-18.5	0	0.039	0.095	0.067	0.202	6	29.9
18.5-19	0	0.001	0.008	0.002	0.01	0.3	30.5
19-19.5	0	0	0.004	0	0.004	0.1	36.5
TSN(10 ⁹)	105.152	106.59	39.288	1.958	252.988		
TSB(10 ³ t)	316.8	954.2	638.5	39.7		1949.1	
Mean length	9.2	12.7	15.1	16.1	11.7		
Mean weight (g)	3	9	16.3	20.3	7.7		
SSN(10 ⁹)	0.084	17.325	32.013	1.959	51.381		
SSB(10 ³ t)	1.4	263.8	568.5	39.7		873.7	

Table 5.2.1.2. Barents Sea capelin. Acoustic estimates of the stock by age in autumn. Biomass (B) in 10^6 tonnes, average weight (AW) in grams. All estimates based on TS = 19.1Log L -74.0 dB

Year	Age										
	1		2		3		4		5		Sum 1+
	B	AW	B	AW	B	AW	B	AW	B	AW	B
1973	1.69	3.2	2.32	6.2	0.73	18.3	0.41	23.8	0.01	30.1	5.14
1974	1.06	3.5	3.06	5.6	1.53	8.9	0.07	20.8	+	25	5.73
1975	0.65	3.4	2.39	6.9	3.27	11.1	1.48	17.1	0.01	31	7.81
1976	0.78	3.7	1.92	8.3	2.09	12.8	1.35	17.6	0.27	21.7	6.42
1977	0.72	2	1.41	8.1	1.66	16.8	0.84	20.9	0.17	22.9	4.8
1978	0.24	2.8	2.62	6.7	1.2	15.8	0.17	19.7	0.02	25	4.25
1979	0.05	4.5	2.47	7.4	1.53	13.5	0.1	21	+	27	4.16
1980	1.21	4.5	1.85	9.4	2.83	18.2	0.82	24.8	0.01	19.7	6.71
1981	0.92	2.3	1.83	9.3	0.82	17	0.32	23.3	0.01	28.7	3.9
1982	1.22	2.3	1.33	9	1.18	20.9	0.05	24.9			3.78
1983	1.61	3.1	1.9	9.5	0.72	18.9	0.01	19.4			4.23
1984	0.57	3.7	1.43	7.7	0.88	18.2	0.08	26.8			2.96
1985	0.17	4.5	0.4	8.4	0.27	13	0.01	15.7			0.86
1986	0.02	3.9	0.05	10.1	0.05	13.5	+	16.4			0.12
1987	0.08	2.1	0.02	12.2	+	14.6	+	34			0.1
1988	0.07	3.4	0.35	12.2	+	17.1					0.43
1989	0.61	3.2	0.2	11.5	0.05	18.1	+	21			0.86
1990	2.66	3.8	2.72	15.3	0.44	27.2	+	20			5.83
1991	1.52	3.8	5.1	8.8	0.64	19.4	0.04	30.2			7.29
1992	1.25	3.6	1.69	8.6	2.17	16.9	0.04	29.5			5.15
1993	0.01	3.4	0.48	9	0.26	15.1	0.05	18.8			0.8
1994	0.09	4.4	0.04	11.2	0.07	16.5	+	18.4			0.2
1995	0.05	6.7	0.11	13.8	0.03	16.8	0.01	22.6			0.19
1996	0.24	2.9	0.22	18.6	0.05	23.9	+	25.5			0.5
1997	0.42	4.2	0.45	11.5	0.04	22.9	+	26.2			0.91
1998	0.81	4.5	0.98	13.4	0.25	24.2	0.02	27.1	+	29.4	2.06
1999	0.65	4.2	1.38	13.6	0.71	26.9	0.03	29.3			2.77
2000	1.7	3.8	1.59	14.4	0.95	27.9	0.08	37.7			4.27
2001	0.37	3.3	2.4	11	0.81	26.7	0.04	35.5	+	41.4	3.63
2002	0.23	3.9	0.92	10.1	1.04	20.7	0.02	35			2.21
2003	0.2	2.4	0.1	10.2	0.2	18.4	0.03	23.5			0.53
2004	0.2	3.8	0.29	11.9	0.12	21.5	0.02	23.5	+	26.3	0.63
2005	0.1	3.7	0.19	14.3	0.04	20.8	+	25.8			0.32
2006	0.29	4.8	0.35	16.1	0.14	24.8	0.01	30.6	+	36.5	0.79
2007	0.93	4.2	0.85	15.5	0.1	27.5	+	28.1			1.88
2008	0.97	3.1	2.8	12.1	0.61	24.6	0.05	30			4.43
2009	0.42	3.4	1.82	10.9	1.51	24.6	0.01	28.6			3.76
2010	0.74	3	1.3	10.2	1.43	23.4	0.02	26.3			3.5
2011	0.5	2.4	1.76	9.7	1.21	21.9	0.23	29.1			3.71
2012	0.54	3.7	1.37	8.8	1.62	18.5	0.06	25			3.59
2013	1.04	3.2	1.81	8.4	0.94	15.9	0.16	23.2	0	29.1	3.96
2014*	0.32	3	0.96	9	0.64	16.3	0.04	20.3	0	0	1.96
Average	0.66	3.55	1.36	10.59	0.87	19.29	0.21	24.80	0.06	26.25	3.03

*Not compensated for incomplete survey coverage

Table 5.2.1.3 Table on summary of stock size estimates for capelin. The figures are not compensated for incomplete survey coverage

Year class		Age	Number (10 ⁹)		Mean weight (g)		Biomass (10 ³ t)	
2013	2012	1	105.2	324.5	3	3.2	316.8	1036.3
2012	2011	2	106.6	216.2	9	8.4	954.2	1810.9
2011	2010	3	39.3	59.2	16.3	16	638.5	944.1
2010	2009	4	2	7.1	20.3	23.2	39.7	164.3
Total stock in:								
2014	2013	1-4	253	606.9	7.7	6.5	1949.1	3955.7

Based on TS value: $19.1 \log L - 74.0$, corresponding to $\sigma = 5.0 \cdot 10^7 \cdot L^{1.91}$

Total mortality calculated from surveys

Table 5.2.1.4 shows the number of fish in the various year classes, and their “survey mortality” in transition from age one to two. As there has been no fishing on these age groups, the figures for total mortality constitute only natural mortality (M). The estimates of M have varied considerably, but give quite good indications of the predation on capelin, given the constraints of survey uncertainties. In 2008, 2010 and 2013, M was estimated to a negative value. This shows that in those years either the one-year group was underestimated or the two-year group was overestimated or a combination of those. This year the estimate of M was the highest since 2005. It is highly likely that the estimate of 2-year-olds this year is biased low due to incomplete survey coverage, and that this will bias high the estimate of M, but the extent of this source of systematic error is not known.

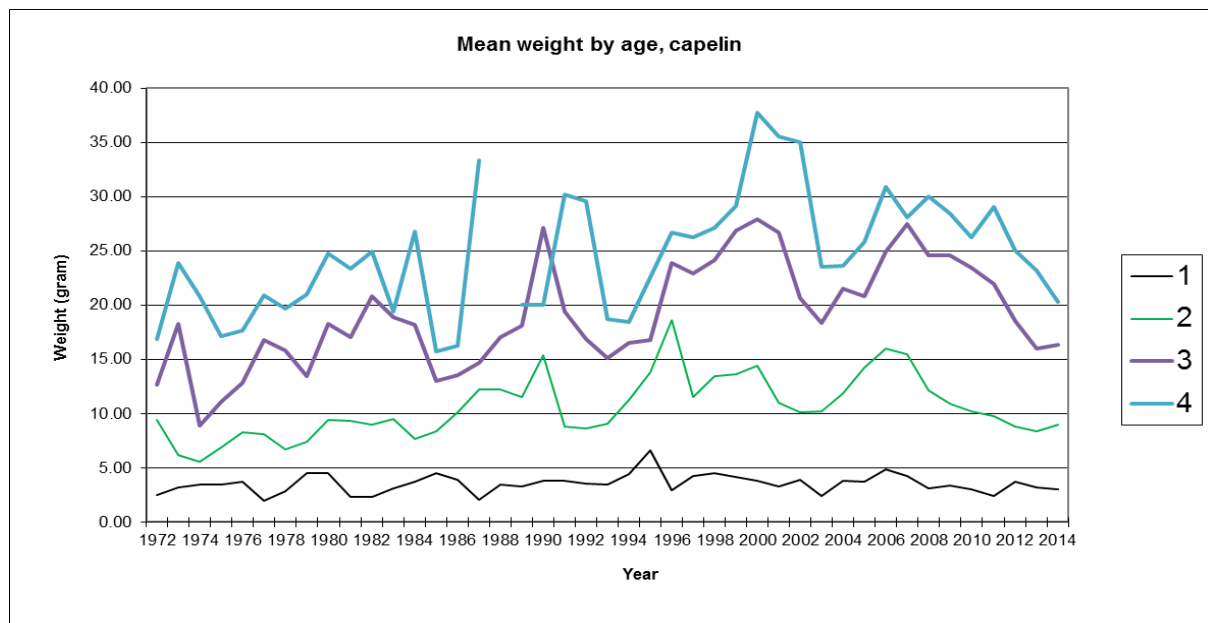


Figure 5.2.1.4 Weight at age (grams) for capelin from capelin surveys and BESS

Table 5.2.1.4. Barents Sea capelin. Survey mortalities from age 1 to age 2

Year	Year class	Age 1 (10 ⁹)	Age 2 (10 ⁹)	Total mort. %	Total mort. Z
1984-1985	1983	154.8	48.3	69	1.16
1985-1986	1984	38.7	4.7	88	2.11
1986-1987	1985	6	1.7	72	1.26
1987-1988	1986	37.6	28.7	24	0.27
1988-1989	1987	21	17.7	16	0.17
1989-1990	1988	189.2	177.6	6	0.06
1990-1991	1989	700.4	580.2	17	0.19
1991-1992	1990	402.1	196.3	51	0.72
1992-1993	1991	351.3	53.4	85	1.88
1993-1994	1992	2.2	3.4	-	-
1994-1995	1993	19.8	8.1	59	0.89
1995-1996	1994	7.1	11.5	-	-
1996-1997	1995	81.9	39.1	52	0.74
1997-1998	1996	98.9	72.6	27	0.31
1998-1999	1997	179	101.5	43	0.57
1999-2000	1998	155.9	110.6	29	0.34
2000-2001	1999	449.2	218.7	51	0.72
2001-2002	2000	113.6	90.8	20	0.22
2002-2003	2001	59.7	9.6	84	1.83
2003-2004	2002	82.4	24.8	70	1.2
2004-2005	2003	51.2	13	75	1.39
2005-2006	2004	26.9	21.7	19	0.21
2006-2007	2005	60.1	54.8	9	0.09
2007-2008	2006	221.7	231.4	-	-
2008-2009	2007	313	166.4	47	0.63
2009-2010	2008	124	127.9	-	-
2010-2011	2009	247.7	181.1	27	0.31
2011-2012	2010	209.6	156.3	25	0.29
2012-2013	2011	145.9	216.2	-	-
2013-2014*	2012	324.5	106.6	67	1.11

*Not compensated for incomplete survey coverage

5.2.2 Herring (*Clupea harengus*)

Distribution in 2014

Young herring was widely distributed in the Barents Sea in 2014 (Figure 5.2.2.1). The eastern distribution border was at 45° E, and in the western areas along the continental slope there were mostly herring of older ages. In the central part of the Barents Sea there was dominance of herring of the age groups 1-3 years, in particular 3-year-olds which were present in large quantities. The main concentrations were found between 30° and 45° E from the Murman coast to 73° N.

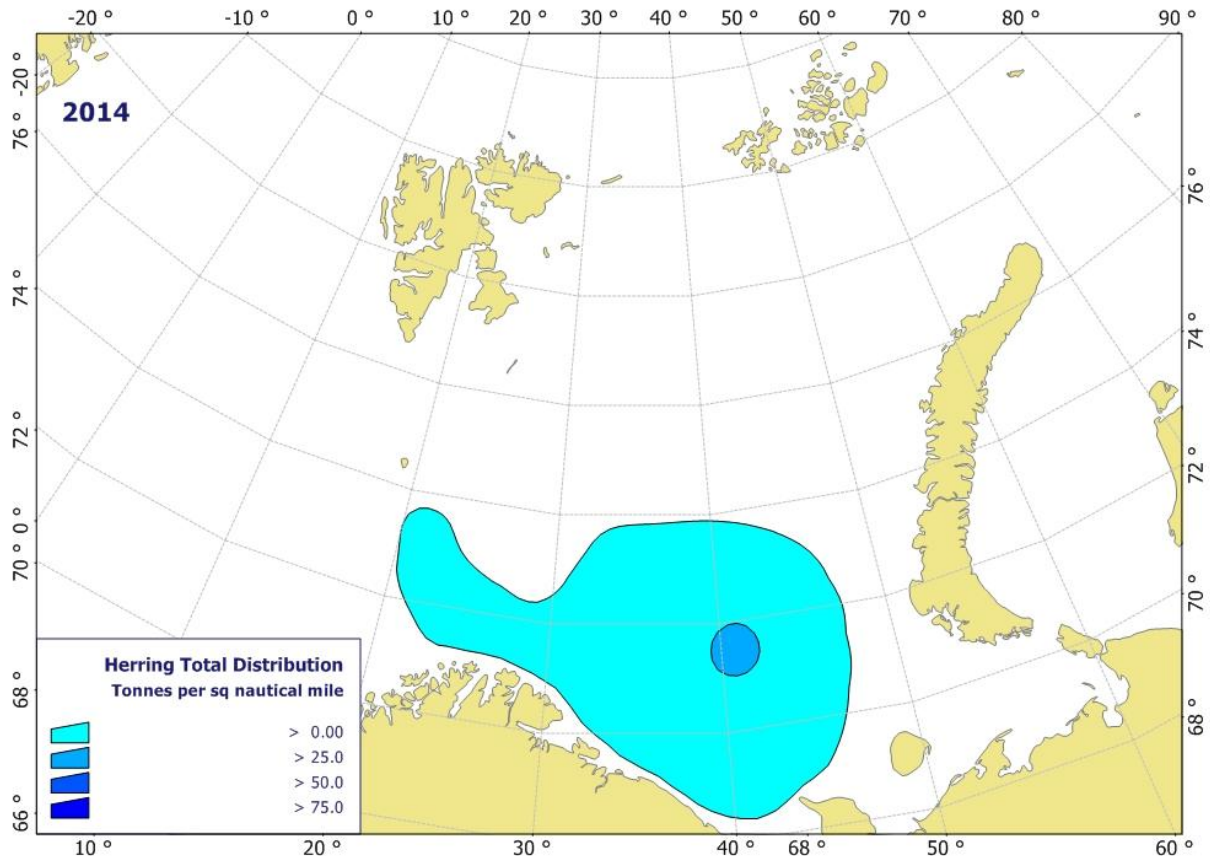


Figure 5.2.2.1 Estimated total density distribution of herring (t/nautical mile²), August-October 2014

Abundance estimation

During the last few years there has been a low abundance of juvenile herring in the Barents Sea. In 2010, herring were practically absent in the eastern and central parts of the Barents Sea. In 2011, the herring abundance further decreased, and the level of the juvenile stock proportion was only 10% of average annual level.

In 2012-2013, the abundance of young herring increased, and biomass continued to increase in 2014, but numbers decreased, and abundance is still below the average annual level. Estimated abundance of herring based on acoustics is shown in Table 5.2.2.1.

Table 5.2.2.1 Norwegian spring spawning herring. Acoustic estimate in the Barents Sea in August-October 2014

Length (cm)	Age / Year class				Sum (10 ⁶)	Biomass (10 ³ t)	Mean weight (g)
	1/2013	2/2012	3/2011	4+/>2010			
9.5	49.14				49.15	0.26	5.35
10.0	245.72				245.72	1.55	6.31
10.5	208.87				208.87	1.54	7.39
11.0	442.30				442.30	3.80	8.59
11.5	159.97	12.04			172.01	1.71	9.91
12.0	430.02				430.02	4.89	11.38
12.5	12.29				12.29	0.16	12.99
13.0	12.29				12.29	0.18	14.75
13.5	24.57				24.57	0.41	16.67
14.0	36.86				36.86	0.69	18.76
14.5	196.58				196.58	4.13	21.03
15.0	159.72				159.72	3.75	23.48
15.5	270.30				270.30	7.06	26.12
16.0	184.29				184.29	5.34	28.96
16.5	110.58				110.58	3.54	32.02
17.0	24.57				24.57	0.87	35.28
17.5	12.29				12.29	0.48	38.78
18.0					12.29	0.52	42.50
18.5					12.29	0.57	46.47
19.5		24.57			24.57	1.36	55.17
20.0		12.29			12.29	0.74	59.92
20.5		49.14			49.15	3.19	64.95
21.0		36.86			36.86	2.59	70.26
21.5		61.43			61.43	4.66	75.87
22.0		98.29			98.29	8.04	81.79
22.5		61.43			61.43	5.41	88.01
23.0			49.14		49.15	4.65	94.56
23.5			61.43		61.43	6.23	101.44
24.0			393.16		393.16	42.72	108.67
24.5		20.90	974.28		995.18	115.68	116.24
25.0			896.89		896.89	111.37	124.18
25.5			700.31		700.31	92.78	132.48
26.0			307.15		307.15	43.36	141.16
26.5			103.20	68.80	172.01	25.84	150.23
27.0			122.86		122.86	19.62	159.70
33.0				24.57	24.57	7.57	307.97
33.5				24.57	24.57	7.95	323.52
34.0				49.14	49.15	16.69	339.60
34.5				86.00	86.00	30.64	356.24
35.0				73.72	73.72	27.53	373.43
35.5				49.14	49.15	19.23	391.19
36.0				61.43	61.43	25.16	409.53
36.5				24.57	24.57	10.53	428.46
37.0				49.14	49.15	22.02	448.00
TSN(10 ⁶)	2580.34	376.95	3608.44	511.11	7101.41		
TSB(10 ³ t)	40.24	28.53	449.49	177.64		696.99	
Mean length (cm)	12.78	21.28	25.00	33.94	20.98		
Mean weight (g)	15.60	75.68	124.57	347.55			98.15

TS=20.0* log(L) - 71.9

The total number of herring in the Barents Sea (ages 1-4) in 2014 was estimated at 7.1 billion individuals, which is somewhat lower than in 2013 (12.8 billion individuals). Estimated herring biomass increased by 30 %. The increase in biomass is due to increased weight of the dominant 2011 yearclass. Comparative estimates of abundance and biomass of herring are shown in Table 5.2.2.2.

Number of 1-year olds decreased by 75% to 2.5 billion individuals from 2013, and remained well below the long-term averages (16.3 billion individuals). In addition, the average weight and length of 1-year olds (15.6 g and 12.8 cm) was lower than last year (26.4 g and 15.8 cm). Historically, the minimum length of 1-year olds in August and September has been set to 12.5 cm, this year it was set to 9.5 cm. This low length is consistent with the data of the International ecosystem survey in the Nordic Seas (IESNS), obtained in May-June 2014 (Figure 5.2.2.2).

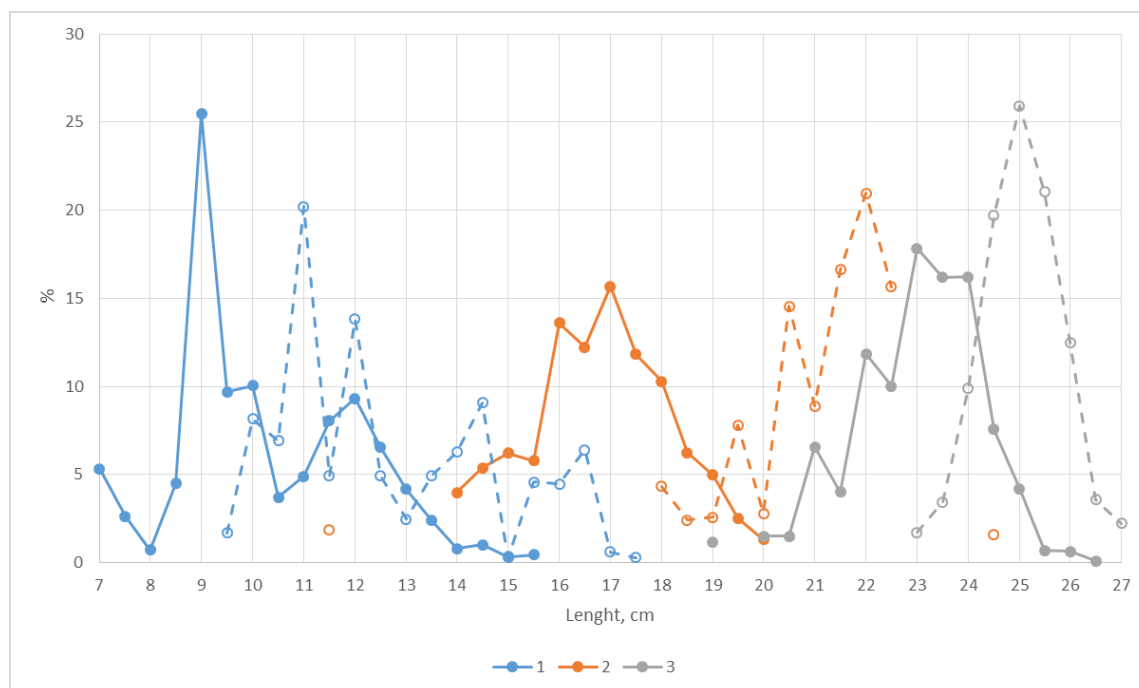


Figure 5.2.2.2. The length of herring in the age of 1-3 years, caught in the Barents Sea in May-June (IESNS, solid line) and in August-September (BESS, dashed line) 2014

There were an estimated 0.37 billion 2-year olds. It is lower than last year (5.0 billion individuals), and accordingly, the estimated biomass of this group in 2014 (29 000 tonnes) was lower than in 2013 (322 000 tonnes). The average length of 2-year group (21.3 cm) was similar as previous year (20.7 cm), but average weight of fish was higher (75.7 g in 2014 and 64.0 g in 2013).

The 3-year olds dominated both in biomass (257 000 tonnes) and numbers (3.6 billion individuals). The average weight and length of the 3-year olds (126 g and 25.0 cm) were lower than in 2013 (138.1 g and 26.4 cm).

In 2014 herring age group spanning from 4 to 13 years were found, mainly in western areas. The estimated number of all group 4+ herring amounted to 511 000 individuals, and biomass to 178 000 tonnes (in 2013 – 57 000 individuals and 8 900 tonnes).

Table 5.2.2.2 Norwegian spring spawning herring. Acoustic estimates by age in autumn 1999-2014. TSN and TSB are total stock numbers (10^6) and total stock biomass (10^3 t)

Age	1		2		3		4+		Sum	
Year	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1999	48758.6	715.9	985.9	31.0	50.7	2.0			49795.2	748.9
2000	14731.0	382.6	11499.0	560.3					26230.0	942.9
2001	524.5	12.0	10544.1	604.3	1714.4	160.0			12783.0	776.3
2002	-	-	-	-	-	-	-	-	-	-
2003	99785.7	3090.3	4335.7	220.1	2475.6	325.5			106596.9	3636.4
2004	14265.0	406.4	36495.0	2725.3	901.0	106.6	45.0	56.0	51717.0	3251.9
2005	46380.0	983.7	16167.0	1054.5	6973.0	795.2			69520.0	2833.4
2006	1618.0	34.2	5535.0	398.4	1250.0	152.3	370.0	58.2	8773.0	643.0
2007	3941.0	147.5	2595.0	217.5	6378.0	810.1	250.0	45.7	13164.0	1220.9
2008**	29.6	0.6	1626.4	76.9	3987.0	287.3	4.1164	523.9	9.7594	888.7
2009	1538.0	48.4	433.0	51.8	1807.0	287.3	1799.0	427.4	5577.00	814.80
2010	1047.0	34.5	315.0	33.7	234.0	37.0	429.0	102.2	2025.0	207.3
2011	95.0	2.9	1504.0	105.5	6.0	0.8			1605.0	109.2
2012	2031.0	36.1	1078.0	65.6	1285.0	194.6			4394.0	296.4
2013	7657.0	202.1	5027.0	321.6	91.0	12.5	57.0	8.9	12832.0	545.2
2014	2580.3	40.24	377.0	28.53	3608.4	449.5	511.11	177.64	7101.41	697.0
1999-2014	16332.1	409.2	6567.8	433.0	2197.2	258.6	433.2	175.0	24808.2	1174.2

*- the primary data has been checked and revised in November 2014

** - including several Kanin herring (mix concentration in south-east area)

5.2.3 Blue whiting (*Micromesistius poutassou*)

The old target strength (TS) used for blue whiting during the BESS differ from the new TS value now used in the main blue whiting surveys west of the British Isles and in the Norwegian Sea. The time series in the Barents Sea needs to be recalculated using the new TS in the future. Consequently, the estimates should, to a greater extent than the other estimates, be considered as relative estimates.

Blue whiting is an important component of the Barents Sea ecosystem. Changes in the status of the stock of blue whiting in the Norwegian Sea are also observed in the Barents Sea.

Distribution

As in previous years, blue whiting was observed in the western part of the Barents Sea. In comparison with 2013, the distribution was a little further to the north along the western coast of Svalbard/Spitsbergen and to east in the central part of Barents Sea (Figure 5.2.3.1).

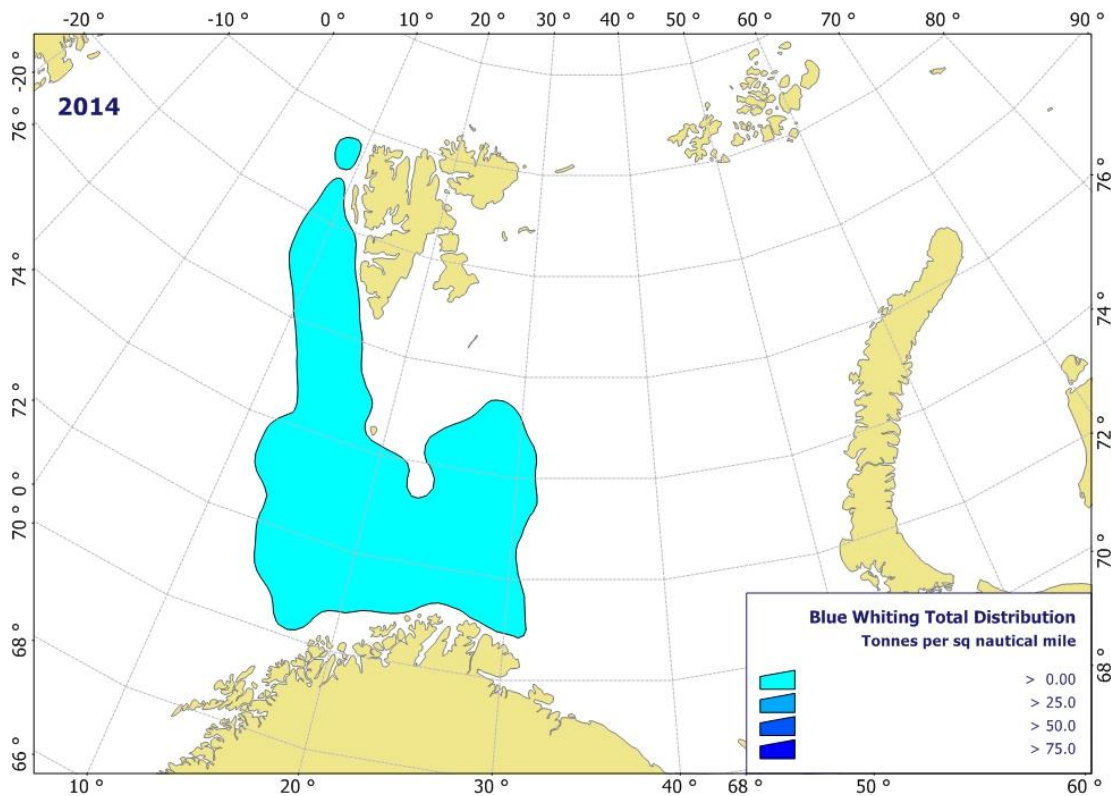


Figure 5.2.3.1. Estimated distribution of blue whiting (t/nautical mile²) based on acoustic recordings, August-October 2014

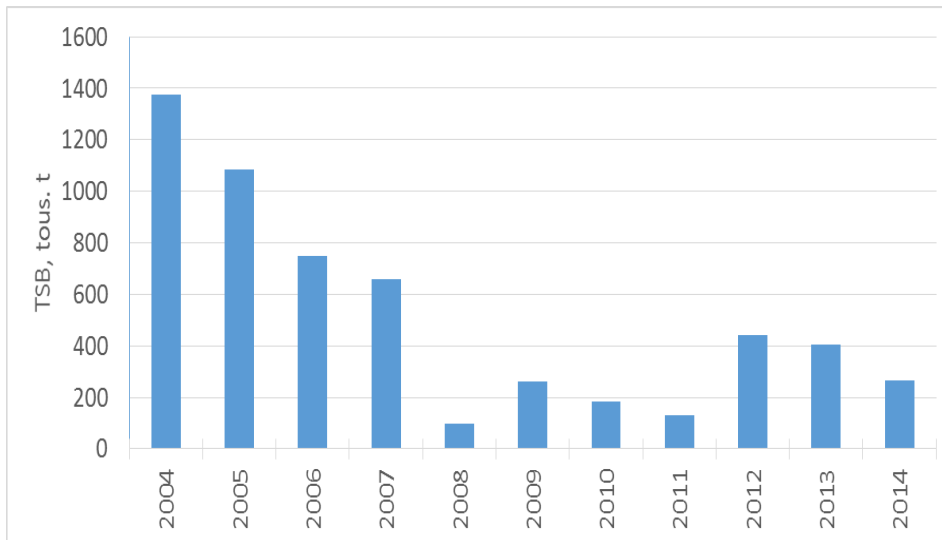


Figure 5.2.3.2 Total biomass of blue whiting in the Barents sea (BESS data)

Abundance estimation

In 2004-2005 estimated biomass of blue whiting in the Barents Sea was higher than 1 million tonnes (Table 5.2.3.1). In 2008, the estimated biomass of blue whiting showed an abrupt reduction, and was 13% of the previous year. Since 2009 the biomass varied and was lower than the 2004-2014 average. Since 2012, there has been a decrease in the estimated abundance of blue whiting in the Barents Sea (Figure 5.2.3.2).

The number of 1-year olds (2013 year class) increased by more than 100 times from previous year to reach an estimated 639 million individuals. The 2011 year class (age 3) still dominated in number, while the number of age 4+ remained similar as last year (Table 5.2.3.1).

Table 6.2.3.1 Blue whiting. Acoustic estimate in the Barents Sea in August-October 2014

Length (cm)	Age/Yearclass												Su m (10 ⁶)	Bioma ss (10 ³ t)	Mean weight(g)
	1	2	3	4	5	6	7	8	9	10	11	12			
	201 3	201 2	201 1	201 0	200 9	200 8	200 7	200 6	200 5	200 4	200 3	200 2			
15.0 - 15.5	1												1		17
16.5 - 17.0	2												2		24.5
17.0 - 17.5	11												11	0.3	26.7
17.5 - 18.0	5												5	0.2	30.1
18.0 - 18.5	73												73	2.3	32
18.5 - 19.0	36												36	1.3	34.5
19.0 - 19.5	152												152	5.7	37.3
19.5 - 20.0	78												78	3.2	41.8
20.0 - 20.5	128												128	6.6	51.6
20.5 - 21.0	47												47	2.4	51
21.0 - 21.5	58												58	3.4	58.6
21.5 - 22.0	33												33	2	61.5
22.0 - 22.5	16		6										22	1.2	55.6
22.5 - 23.0		6											6	0.4	67.9
23.0 - 23.5			17	8									25	1.7	70.6
23.5 - 24.0			17	1									19	1.4	72.6
24.0 - 24.5		31	40	16									87	7.1	81.2
24.5 - 25.0		4	60	6									70	5.9	84
25.0 - 25.5		9	148										157	14.7	93.7
25.5 - 26.0			88										88	8.7	98.7
26.0 - 26.5			107	6									113	12	105.9
26.5 - 27.0		33	81	16									129	14.9	114.9
27.0 - 27.5			143	2									145	17.6	121.8
27.5 - 28.0			78										78	10	127.6
28.0 - 28.5			61	15									77	10.8	140.8
28.5 - 29.0			32	8									40	5.8	147.5
29.0 - 29.5				46									46	7.3	160.8
29.5 - 30.0			17	1			6						25	4	160.9
30.0 - 30.5			17	14	13		3						47	8.5	179.9
30.5 - 31.0			19				2						21	3.7	173.7
31.0 - 31.5					33								33	6.3	188.9
31.5 - 32.0								12					12	2.3	199.9
32.0 - 32.5							9	4		4			17	3.4	204.6
32.5 - 33.0							2	12	11				26	5.3	204.3
33.0 - 33.5						16	3	9	4				34	7.1	212.6
33.5 - 34.0									18				18	4	222.8
34.0 - 34.5							29		5				34	7.8	230.2
34.5 - 35.0					1		1	10	10	10			31	7.7	247.8
35.0 - 35.5								2	15	15		1	33	8.6	257.4
35.5 - 36.0						16	4	14	19				54	14.3	265
36.0 - 36.5								4	31				35	9.8	279.6
36.5 - 37.0									3	11		16	31	8.8	285.4
37.0 - 37.5									18	1			19	6.1	320.2
37.5 - 38.0									10	5	1		15	4.7	310.1
38.0 - 38.5						7			1		1		9	3.2	369.1
38.5 - 39.0										7	2		9	3.1	345.8
39.5 - 40.0											1		1	0.4	383
40.0 - 40.5											2		2	0.7	400.6
TSN (10 ⁶)	639	83	932	139	47	40	49	78	145	55	4	18	222		
	28.		104.					17.					9		
TSB (10 ³ t)	3	7.9	1	18.5	8.8	10.4	11	3	38.5	15.4	1.5	5		266.8	
Mean length (cm)	19.	25.	26.5	27.6	31	35.2	33.9	33.	35.5	36.1	38.7	36.7			26.2
Mean weight (g)	44.	95.	111.	132.	187.	261.	226.	221	264.	278.	353.	286.			119.7
	3	3	7	9	2	6	7	7	4	9	1	4			

Table 5.2.3.2 Blue whiting. Acoustic estimates by age in autumn 2004-2014. TSN and TSB are total stock numbers (10^6) and total stock biomass (10^3)

Age/year	1		2		3		4+		Sum	
	N	B	N	B	N	B	N	B	N	B
2004	5787	219.1	3801	285.5	2878	264.8	4780	606.5	17268	1376.8
2005	4871	132.0	2770	180.0	4205	363.0	3213	409.8	15058	1084.1
2006	371	21.2	2227	158.8	2665	238.1	2491	330.6	7754	748.8
2007	3	0.1	245	23.2	2934	292.2	2221	315.1	5666	657.6
2008	3	0.1	2	0.1	11	1.1	604	95.4	620	96.9
2009	2	0.1	2	0.2	2	0.2	1513	260.8	1519	261.4
2010	0	0	0	0	13	2.8	884	179.3	897	182.6
2011	31	2.0	15	1.7	80	15.6	466	110.4	592	129.7
2012	2686	124.7	354	42.9	157	25.7	1046	248.1	4242	441.3
2013	5	0.4	610	61.9	83	12.5	595	143.1	3658	406.5
2014	639	28.3	83	7.9	932	104.1	575	126.4	2229	266.8
Mean 2004-2014	1309	48.0	919	69.3	1269	120.0	1672	256.9	5409	513.9

5.2.4 Polar cod (*Boreogadus saida*)

Distribution

Low abundances of polar cod were found in the traditional distribution area in the northern and the eastern Barents Sea, more specifically along the south coast of Novaya Zemlya and south of Franz Josef Land. The polar cod distribution area was also smaller compared to previous years, and hardly any polar cod were found to the west of 40 degrees east. No high density regions were recorded. The total geographical density distribution of polar cod inside the survey area is shown in Figure 5.2.4.1.



Figure 5.2.4.1 Estimated total density distribution of polar cod (t/sq nautical mile), August-October 2014

Abundance estimation

The stock abundance estimate by age, number, and weight was calculated using the same methods as for capelin. A detailed estimate is given in Table 5.2.4.1, and the time series of abundance estimates is summarized in Table 5.2.4.2. The main results of the abundance in 2014 are summarized in table 5.2.4.3.

The following summarizes the results from the Barents Sea component: The estimated number of individuals in the 2013 year-class (the one-year-olds) is only 31% of the 2012 year-class measured as one-year-olds in 2013. The mean weight on the other hand, is a little higher, so the biomass of one-year-olds is ca. 36% of that estimated for the one-group in 2013. The abundance of the 2012 year class (the two-year-olds) is 4.4 billions, similar as

corresponding age groups found in the two preceding years, and the mean weight was also similar. The biomass of two year-olds has therefore been stable the last three years. The abundance of three-years-old fish (2011 year class) decreased by ca. 39% from last year. The mean weight is also a little lower, so the biomass was reduced by ca. 42%, compared to the corresponding age group during the 2013 survey. The four-year-olds (2010 year class) were scarce, but had a higher mean weight than for the four-year-olds in 2013. No fish of age 5 or higher were found. The total size of the part of the stock covered, estimated at 0.24 million tonnes, is a ca. 30% reduction from last year.

After the decrease of the polar cod stock size in 2012, it has stabilized on a lower level. Age groups 2+ were obviously underestimated in 2012, but in any case significant increase in natural mortality and stock size reduction in recent years have been observed.

Total mortality calculated from surveys

Table 5.2.4.4 shows the “survey-mortality rates” of polar cod in the period 1985 to 2014. The mortality estimates are unstable during the whole period. Although unstable mortalities may indicate errors in the stock size estimation from year to year due to incomplete coverage and other reasons, the impression remains that there is a considerable total mortality on young polar cod. Prior to 1993, these mortality estimates represented natural mortality only, as practically no fishing took place. In the period 1993 to 2006 catches were at a level between 1 and 50 000 tonnes. Since there has been a minimum landing size of 13 cm in that fishery, a considerable amount of this could consist of two- and even one-year-olds, and this may explain some, but only a small part of the high total mortality. Negative survey mortalities were registered for age groups 1-2 from 2003-2004, 2006-2007 and 2009-2010 and also now from 2013-2014. This same was seen for age group 2-3 in 1998-1999, 2003-2004 and 2012-2013, confirming the previously expressed impression that, for some years and for various reasons, population numbers might have been underestimated.

Table 5.2.4.1 Barents Sea polar cod. Acoustic estimate in August-October 2014

Length (cm)	Age/Year class						Mean weight (g)
	1	2	3	4	Sum	Biomass	
	2013	2012	2011	2010	(10 ⁹)	(10 ³ t)	
6.5-7						0	2.7
7-7.5						0	3
7.5-8	1				1	0	2.8
8-8.5	2				2	0	4.5
8.5-9	13				13	0.1	4.6
9-9.5	30				30	0.2	5.6
9.5-10	52	1			53	0.3	6.5
10-10.5	59	1			60	0.4	7.4
10.5-11	138	3	2		143	1.2	8.3
11-11.5	116	3	1		120	1.1	9.6
11.5-12	122	11	2		135	1.4	10.2
12-12.5	75	18	12		105	1.3	12.6
12.5-13	79	77	2		158	2	12.8
13-13.5		77	1		79	1.1	14.4
13.5-14		189	4		193	3.5	18.1
14-14.5		247	1		248	4.5	18.1
14.5-15		608	2		610	12.2	20
15-15.5		744	4		748	17.2	23
15.5-16		862	2		863	22.2	25.7
16-16.5		643	7		650	19	29.3
16.5-17		319	416		736	20.9	28.4
17-17.5		522	133		655	20.8	31.8
17.5-18		1	590		591	21.2	35.9
18-18.5		1	537		538	18.3	34.1
18.5-19		110	331		441	15.8	35.8
19-19.5			334		334	13.6	40.7
19.5-20			237		237	10.1	42.8
20-20.5			267		267	12.5	46.8
20.5-21			112		112	6.4	57
21-21.5			93		93	5	53.7
21.5-22			107		107	5.6	52.1
22-22.5				44	44	2.6	59
22.5-23				3	3	0.2	64.1
23-23.5				18	18	1.2	65.3
24-24.5				1	1	0.1	75.3
25-25.5				14	14	1.2	87
26.5-27						0	109
TSN(10 ⁶)	687	4439	3196	80	8402	.	.
TSB(10 ³ t)	6.5	110	121	5.3	.	243.2	.
Mean length (cm)	11.2	15.6	18.6	23	.	.	.
Mean weight (g)	9.4	24.8	37.9	65.7	.	.	28.9

Table 5.2.4.2 Barents Sea polar cod. Acoustic estimates by age in August-October. TSN and TSB is total stock numbers (10^6) and total stock biomass (10^3 tonnes) respectively

Year	Age 1		Age 2		Age 3		Age 4+		Total	
	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB	TSN	TSB
1986	24038	169.6	6263	104.3	1058	31.5	82	3.4	31441	308.8
1987	15041	125.1	10142	184.2	3111	72.2	39	1.2	28333	382.8
1988	4314	37.1	1469	27.1	727	20.1	52	1.7	6562	86.0
1989	13540	154.9	1777	41.7	236	8.6	60	2.6	15613	207.8
1990	3834	39.3	2221	56.8	650	25.3	94	6.9	6799	127.3
1991	23670	214.2	4159	93.8	1922	67.0	152	6.4	29903	381.5
1992	22902	194.4	13992	376.5	832	20.9	64	2.9	37790	594.9
1993	16269	131.6	18919	367.1	2965	103.3	147	7.7	38300	609.7
1994	27466	189.7	9297	161.0	5044	154.0	790	35.8	42597	540.5
1995	30697	249.6	6493	127.8	1610	41.0	175	7.9	38975	426.2
1996	19438	144.9	10056	230.6	3287	103.1	212	8.0	33012	487.4
1997	15848	136.7	7755	124.5	3139	86.4	992	39.3	28012	400.7
1998	89947	505.5	7634	174.5	3965	119.3	598	23.0	102435	839.5
1999	59434	399.6	22760	426.0	8803	286.8	435	25.9	91463	1141.9
2000	33825	269.4	19999	432.4	14598	597.6	840	48.4	69262	1347.8
2001	77144	709.0	15694	434.5	12499	589.3	2271	132.1	107713	1869.6
2002	8431	56.8	34824	875.9	6350	282.2	2322	143.2	52218	1377.2
2003	15434	114.1	2057	37.9	2038	63.9	1545	64.4	21074	280.2
2004	99404	627.1	22777	404.9	2627	82.2	510	32.7	125319	1143.8
2005	71675	626.6	57053	1028.2	3703	120.2	407	28.3	132859	1803.3
2006	16190	180.8	45063	1277.4	12083	445.9	698	37.2	74033	1941.2
2007	29483	321.2	25778	743.4	3230	145.8	315	19.8	58807	1230.1
2008	41693	421.8	18114	522.0	5905	247.8	415	27.8	66127	1219.4
2009	13276	100.2	22213	492.5	8265	280.0	336	16.6	44090	889.3
2010	27285	234.2	18257	543.1	12982	594.6	1253	58.6	59777	1430.5
2011	34460	282.3	14455	304.4	4728	237.1	514	36.7	54158	860.5
2012	13521	113.6	4696	104.3	2121	93.0	119	8.0	20457	318.9
2013	2216	18.1	4317	102.2	5243	210.3	180	9.9	11956	340.5
2014	687	6.5	4439	110	3196	121	80	5.3	8402	243.2
Average	29350	234	14920	342	4721	181	541	29	49569	787

Based on TSvalue = 21.8 Log L - 72.7 dB

Table 5.2.4.3 Summary of stock size estimates for polar cod

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
2013	2012	1	0.7	2.2	9.4	8.2	6.5	18.1
2012	2011	2	4.4	4.3	24.8	23.7	110	102.2
2011	2010	3	3.2	5.2	37.9	40.1	121	210.3
2010	2009	4	0.1	0.2	65.7	54.9	5.3	9.9
Total stock in								
2014	2013	1-4	8.4	12.0	28.9	28.5	243.2	340.5
Based on TS value: $21.8 \log L - 72.7$, corresponding to $\sigma = 6.7 \cdot 10^7 \cdot L^{2.18}$								

Table 5.2.4.4 Barents Sea polar cod. Survey mortalities for age transitions 1-2 (top) and 2-3 (bottom)

Year	Year class	Age 1 (10^9)	Age 2 (10^9)	Total mort. %	Total mort Z
1986-1987	1985	24.0	10.1	58	0.87
1987-1988	1986	15.0	1.5	90	2.30
1988-1989	1987	4.3	1.8	58	0.87
1989-1990	1988	13.5	2.2	84	1.81
1990-1991	1989	3.8	4.2	-11	-0.10
1991-1992	1990	23.7	14.0	41	0.53
1992-1993	1991	22.9	18.9	17	0.19
1993-1994	1992	16.3	9.3	43	0.56
1994-1995	1993	27.5	6.5	76	1.44
1995-1996	1994	30.7	10.1	67	1.11
1996-1997	1995	19.4	7.8	60	0.91
1997-1998	1996	15.8	7.6	52	0.73
1998-1999	1997	89.9	22.8	75	1.37
1999-2000	1998	59.4	20.0	66	1.09
2000-2001	1999	33.8	15.7	54	0.77
2001-2002	2000	77.1	34.8	55	0.80
2002-2003	2001	8.4	2.1	75	1.39
2003-2004	2002	15.4	22.7	-47	-0.39
2004-2005	2003	99.4	57.1	43	0.55
2005-2006	2004	71.7	45.1	37	0.46
2006-2007	2005	16.2	25.8	-59	-0.47
2007-2008	2006	29.5	18.1	39	0.49
2008-2009	2007	41.7	22.2	47	0.63
2009-2010	2008	13.2	18.3	-39	-0.33
2010-2011	2009	27.3	14.5	47	0.63
2011-2012	2010	34.4	4.6	87	2.01
2012-2013	2011	13.5	4.3	68	1.14
2013-2014	2012	2.2	4.4	-50	-0.69
Year	Year class	Age 2 (10^9)	Age 3 (10^9)	Total mort. %	Total mort Z
1986-1987	1984	6.3	3.1	51	0.71
1987-1988	1985	10.1	0.7	93	2.67
1988-1989	1986	1.5	0.2	87	2.01
1989-1990	1987	1.8	0.7	61	0.94
1990-1991	1988	2.2	1.9	14	0.15
1991-1992	1989	4.2	0.8	81	1.66
1992-1993	1990	14.0	3.0	79	1.54
1993-1994	1991	18.9	5.0	74	1.33
1994-1995	1992	9.3	1.6	83	1.76
1995-1996	1993	6.5	3.3	49	0.68
1996-1997	1994	10.1	3.1	69	1.18
1997-1998	1995	7.8	4.0	49	0.67
1998-1999	1996	7.6	8.8	-16	-0.15
1999-2000	1997	22.8	14.6	36	0.45
2000-2001	1998	20.0	12.5	38	0.47
2001-2002	1999	15.7	6.4	59	0.90
2002-2003	2000	34.8	2.0	94	2.86
2003-2004	2001	2.1	2.6	-24	-0.21
2004-2005	2002	22.8	3.7	84	1.82
2005-2006	2003	51.7	12.1	77	1.45
2006-2007	2004	45.1	3.2	93	2.65
2007-2008	2005	25.8	5.9	77	1.48
2008-2009	2006	18.1	8.3	54	0.78
2009-2010	2007	22.2	13.0	41	0.54
2010-2011	2008	18.3	4.7	74	1.36
2011-2012	2009	14.5	2.1	85	1.92
2012-2013	2010	4.7	5.2	-11	-0.10
2013-2014	2011	4.3	3.2	26	0.30

