

# Preliminary cruise report: Acoustic assessment of the Iceland-East Greenland-Jan Mayen capelin stock in January 2023.

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## Objective

The main objective of the winter survey conducted in January 2023 was acoustic assessment of the maturing part of the capelin stock. First, on 11 - 21 January, there was conducted a scouting acoustic and trawling survey (founded by Fisheries Iceland) by the research vessel Arni Fridriksson with the main purpose to map the condition, distribution and migration path of the capelin to give guidelines for coming stock measurements. Based on that, on 23 - 31 January acoustic measurements and sampling were undertaken by two research vessels and 3 fishing vessels assisted. 1-4 Scientists from MFRI were on board each vessel and all assessments were based on acoustic data from calibrated echosounders. Echosounders of the two research vessels had been calibrated in previous November and December while three fishing vessels were calibrated immediately after the survey.

## Methods

### Survey area and conditions

The survey area was on and along the shelf edge from Vikurall northwest of Iceland and eastwards along and outside shelf slopes north of Iceland and Eastfjords to Litladypi southeast of Iceland (Figure 1). The acoustic measurements were conducted by the research vessels Arni Fridriksson and Bjarni Sæmundsson and the fishing vessels Asgrimur Halldorsson, Jona Edvalds and Heimaey with 1 - 4 scientist from the Marine and Freshwater Research Institute onboard each vessel. The fishing vessels were funded by Fisheries Iceland. Arni Fridriksson and Bjarni Sæmundsson started north of the Melrakkasletta peninsula at Thistilfjardargrunn bank, Arni covering westwards and Bjarni to the east. Asgrimur and Jona Edvalds progressed from Litladypi southeast of Iceland and northwards along and outside the shelf edges towards the coverage of Bjarni while Heimaey started with two transects off Hvalbakshalli based on southerly occurrence of capelin just observed by Asgrimur and Jona, then Heimaey searched the shelf northwards along the Eastfjords. When the three fishingvessels approached the southeastwards progress of Bjarni the joined in on the transects northeast of Iceland (Jona Edvalds) and north of Iceland (Asgrimur Halldorsson and Heimaey) to facilitate the westward progress of the stock estimate before measurements would be hindered by forecasted wind and heavy seas. The fishing vessels then headed to Eastfjords for calibration. The echosounders of all three fishing vessels were calibrated in Eskifjordur on Saturday 25 January, while the two research vessels continued the westward progress and finished measuring by Kogurgrunn bank north of Westfjords as seaice hindered further measurements in the Denmark Strait. Overall, the vessels managed to cover the planned survey area except the hindered coverage in Denmark Strait due to sea ice. The survey strategy was designed based on forecasts showing very short time of favorable weather and seastate conditions for acoustic measurements. Vessels had occasionally to slow or halt due to bad weather but in general good progress was maintained and most abundant areas were measured in good conditions.

### Acoustic sampling

Acoustic data was sampled with Simrad EK80 or ES70 and ES80 echosounders at one to five frequencies. The data were scrutinized by a scientist onboard each vessel using LSSS (version 2.9.0) software where capelin backscatter at 38 kHz was defined and its Nautical Area Scattering Coefficient (NASC) in SA units ( $m^2/nmi^2$ ) calculated at 0.1 nmi integration intervals. Then, average NASC within squares of 15 minutes latitude and 30 minutes longitude was calculated. Abundance in numbers was estimated using a length dependent target strength relationship (TS; in dB re  $1m^2$ )

$$TS = 19.1 * \log(L) - 74.5$$

Total length of the capelin was measured to nearest mm. For each length interval within the length distribution of capelin in the samples the following parameters were calculated: backscattering proportion, number and weight.

$$\sigma_L = 4 * \pi * 10^{TS_L/10}$$

$$C_L = \frac{\sum_L (C_{sL} * \sigma_L) * N_{ASC} * A}{\sigma_L}$$

$$W_L = C_L * \overline{W_{sL}}$$

Where L is measured length,  $\sigma$  is backscattering cross-section, C is total number, Cs is number in sample, A is surface area and Ws is average weight in sample.

### Biological sampling:

**Pelagic trawl:** Total length and weight of up to 100 individual capelin fish was measured for a subsample from the catch at each trawl station. Also, sex and maturity were estimated visually and the roe from maturing capelin were weighted. Samples were processed onboard the two research vessels and age was estimated from otoliths on board r/v Arni Fridriksson while all other otoliths were analyzed in landbased laboratories. All samples collected by the fishing vessels were processed and age estimated in landbased laboratories after the survey.

## Results

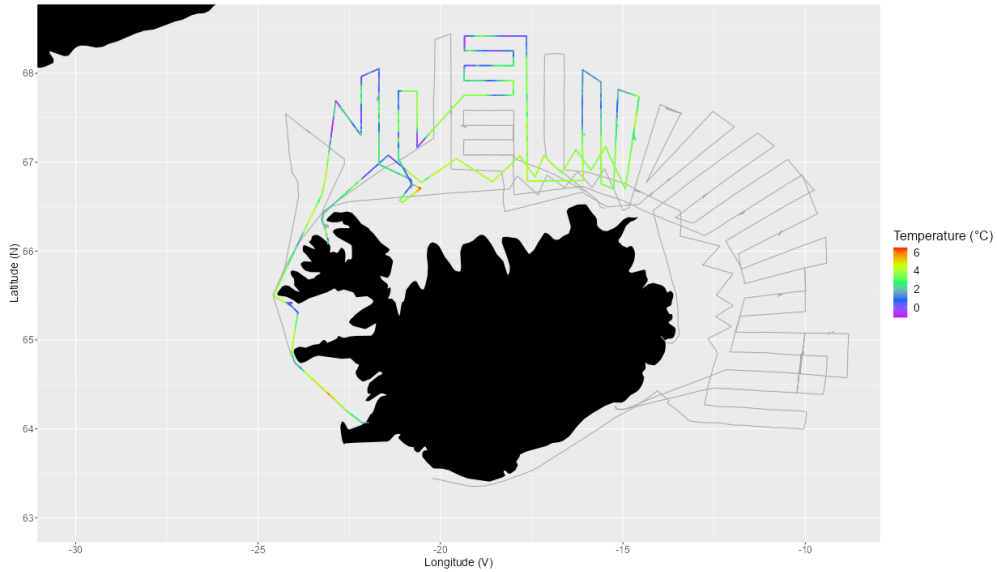


Figure 1: Routes of the participating vessels. Route of Arni Friðriksson with sea surface temperature (SST) color scale as measured onboard.

### Distribution, biomass and age composition of capelin

Mature capelin dominated in main parts of the survey area while immature capelin was mainly observed by the ice edge in the proximity of Hornall north of Westfjords peninsula. Most abundance of maturing capelin was northeast of Iceland and part of it observed migrating into the shelf areas by Rifsbanki bank. Furthest to southeast on the survey area, older and larger capelin predominated. Most of the biomass was measured while vessels were progressing against the direction of capelin migration, which might lead to underestimate of the stock size. Further, there might be unmeasured stock components in Denmark Strait due to survey restrictions caused by sea ice in that region.

The survey results give capelin SSB of 732 000 tonnes.

Length disaggregated biomass is shown in tables 1-6. The total number of capelin amounted to 35 billion. The total biomass estimate was 766 000 tonnes where of about 732 000 tonnes were maturing capelin.

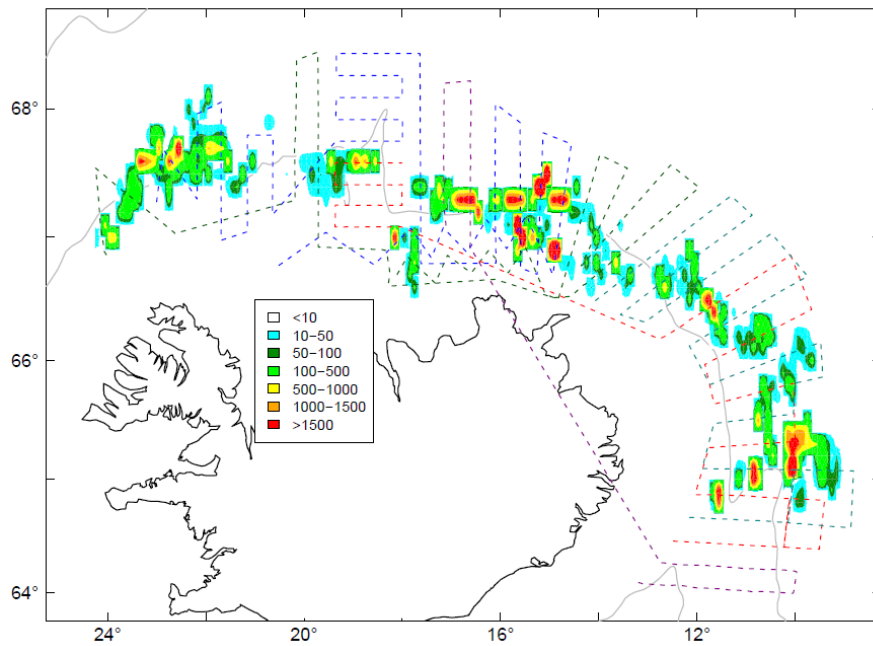


Figure 2: Capelin distribution as relative density of acoustic backscatter during the survey.

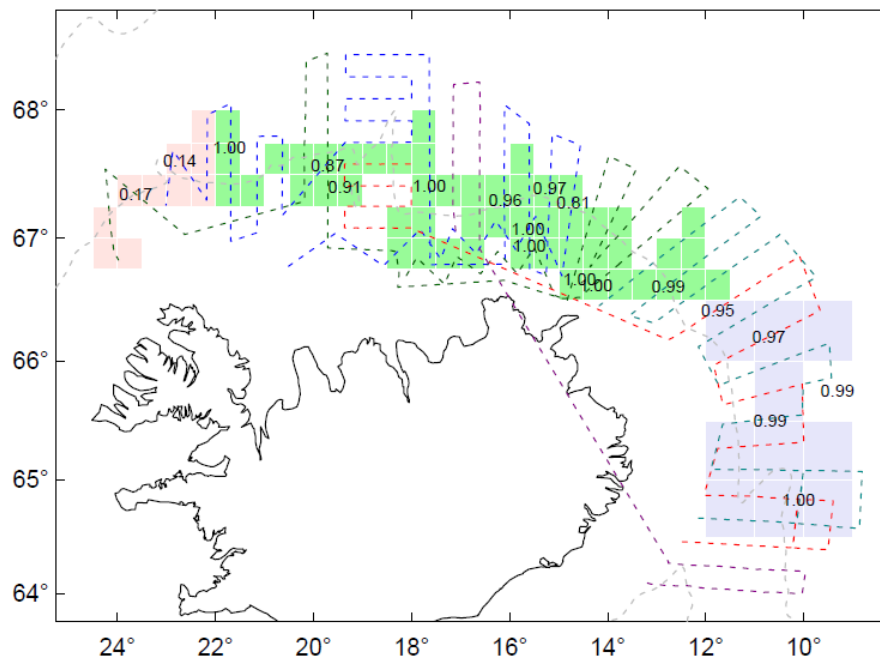


Figure 3: Maturity proportion at each trawl station.

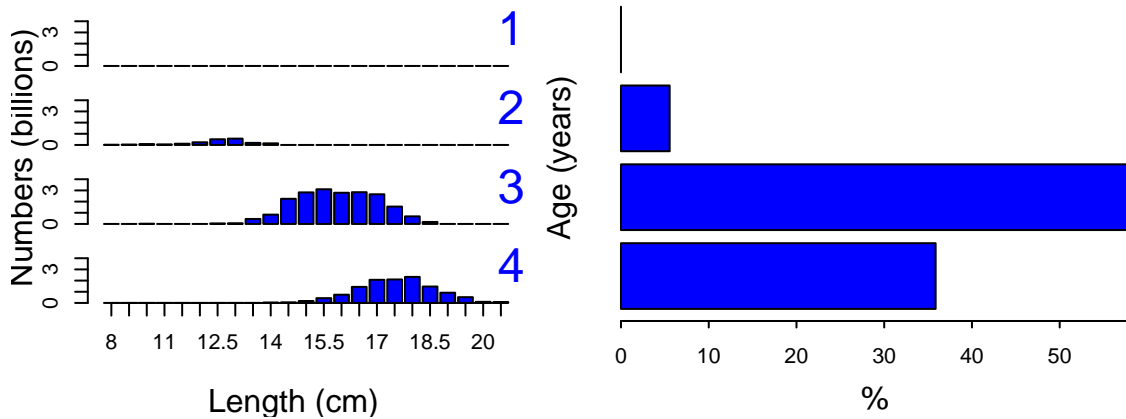
## Total stock

Table 1: Estimated stock size of Iceland-Greenland-Jan Mayen capelin total stock in numbers (millions) by age (years) and length (cm), and biomass (thous. tonnes) from the acoustic surveys in 17. – 30. January 2021. Mean weight is in grams

length	a1	a2	a3	a4	num.sampled	numbers	biomass	weight.mean
8.0	0	16.21	0.00	0.00	1	16.21	24.31	1.50
10.0	0	32.42	0.00	0.00	2	32.42	89.47	2.76
10.5	0	75.29	16.21	0.00	6	91.49	305.48	3.34
11.0	0	46.71	0.00	0.00	3	46.71	160.45	3.44
11.5	0	109.62	0.00	0.00	7	109.62	514.14	4.69
12.0	0	238.23	0.00	0.00	16	238.23	1398.46	5.87
12.5	0	508.59	42.87	0.00	37	551.46	3618.56	6.56
13.0	0	565.75	57.16	0.00	42	622.91	4686.51	7.52
13.5	0	185.78	447.30	0.00	34	633.08	6209.74	9.81
14.0	0	142.90	831.75	30.50	55	1005.15	11560.68	11.50
14.5	0	0.00	2250.16	47.46	110	2297.63	30545.26	13.29
15.0	0	0.00	2823.70	172.88	155	2996.58	45307.24	15.12
15.5	0	0.00	3102.95	427.96	184	3530.91	61008.56	17.28
16.0	0	0.00	2788.44	733.93	184	3538.58	70058.42	19.80
16.5	0	0.00	2840.09	1435.44	216	4275.52	95221.02	22.27
17.0	0	0.00	2652.16	2068.63	235	4720.79	118478.14	25.10
17.5	0	0.00	1552.38	2099.88	178	3652.26	102187.94	27.98
18.0	0	0.00	678.39	2329.11	155	3023.71	93781.08	31.02
18.5	0	0.00	176.37	1467.10	84	1643.46	57550.61	35.02
19.0	0	0.00	0.00	913.37	48	913.37	34282.05	37.53
19.5	0	0.00	0.00	516.32	30	516.32	20854.95	40.39
20.0	0	0.00	0.00	97.25	6	97.25	4046.21	41.61
20.5	0	0.00	0.00	79.88	4	79.88	3762.18	47.10

Table 2: Age (years) aggregated total stock summary. T = Total, S = Stock, N = Numbers(billions), W = Weight(grams), L = Length(Cm), p = %

parameter	a1	a2	a3	a4	All
TSN	0	1.92	20.26	12.42	34.63
TSB	0	13.50	396.61	354.72	765.65
MeanW	0	7.02	19.58	28.56	22.11
MeanL	0	12.54	15.86	17.53	16.28
TSNp	0	5.55	58.50	35.86	100.00



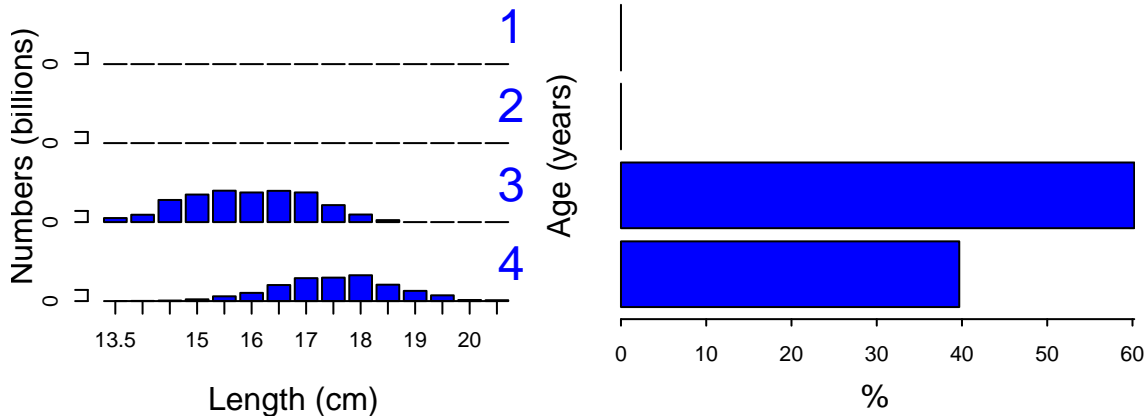
## Spawning stock

Table 3: Estimated stock size of the Iceland-Greenland-Jan Mayen capelin spawning stock component in numbers (millions) by age (years) and length (cm), and biomass (thous. tonnes) from the acoustic surveys in 17. – 30. January 2021. Mean weight is in grams

length	a1	a2	a3	a4	num.sampled	numbers	biomass	weight.mean
13.5	0	0	361.56	0.00	19	361.56	3889.83	10.76
14.0	0	0	658.35	16.21	53	674.56	8102.93	12.01
14.5	0	0	1979.92	47.46	108	2027.38	27353.03	13.49
15.0	0	0	2465.80	158.59	150	2624.39	40301.00	15.36
15.5	0	0	2811.91	427.96	182	3239.87	56437.53	17.42
16.0	0	0	2650.24	733.93	183	3400.38	67759.82	19.93
16.5	0	0	2797.21	1435.44	214	4232.65	94429.33	22.31
17.0	0	0	2652.16	2052.42	235	4704.58	118001.47	25.08
17.5	0	0	1519.96	2099.88	178	3619.84	101435.26	28.02
18.0	0	0	678.39	2312.91	155	3007.51	93326.95	31.03
18.5	0	0	176.37	1467.10	84	1643.46	57550.61	35.02
19.0	0	0	0.00	913.37	48	913.37	34282.05	37.53
19.5	0	0	0.00	516.32	30	516.32	20854.95	40.39
20.0	0	0	0.00	97.25	6	97.25	4046.21	41.61
20.5	0	0	0.00	79.88	4	79.88	3762.18	47.10

Table 4: Age (years) aggregated spawning stock component summary. T = Total, S = Stock, N = Numbers(billions), W = Weight(grams), L = Length(Cm), p = %

parameter	a1	a2	a3	a4	All
SSN	0	0	18.75	12.36	31.14
SSB	0	0	376.92	353.79	731.53
MeanW	0	0	20.10	28.63	23.49
MeanL	0	0	15.95	17.54	16.58
SSNp	0	0	60.21	39.68	100.00



## Immature stock

Table 5: Estimated stock size of the Iceland-Greenland-Jan Mayen capelin immature stock component in numbers (millions) by age (years) and length (cm), and biomass (thous. tonnes) from the acoustic surveys in 17. – 30. January 2021. Mean weight is in grams

length	a1	a2	a3	a4	num.sampled	numbers	biomass	weight.mean
8.0	0	16.21	0.00	0.00	1	16.21	24.31	1.50
10.0	0	32.42	0.00	0.00	2	32.42	89.47	2.76
10.5	0	75.29	16.21	0.00	6	91.49	305.48	3.34
11.0	0	46.71	0.00	0.00	3	46.71	160.45	3.44
11.5	0	109.62	0.00	0.00	7	109.62	514.14	4.69
12.0	0	238.23	0.00	0.00	16	238.23	1398.46	5.87
12.5	0	508.59	42.87	0.00	37	551.46	3618.56	6.56
13.0	0	565.75	57.16	0.00	42	622.91	4686.51	7.52
13.5	0	185.78	85.74	0.00	20	271.52	2319.92	8.54
14.0	0	142.90	173.40	14.29	32	330.60	3457.76	10.46
14.5	0	0.00	270.24	0.00	73	270.24	3192.23	11.81
15.0	0	0.00	357.90	14.29	126	372.19	5006.24	13.45
15.5	0	0.00	291.04	0.00	134	291.04	4571.03	15.71
16.0	0	0.00	138.20	0.00	112	138.20	2298.60	16.63
16.5	0	0.00	42.87	0.00	4	42.87	791.69	18.47
17.0	0	0.00	0.00	16.21	26	16.21	476.66	29.41
17.5	0	0.00	32.42	0.00	54	32.42	752.68	23.22
18.0	0	0.00	0.00	16.21	52	16.21	454.14	28.02

Table 6: Age (years) aggregated immature stock component summary. T = Total, S = Stock, N = Numbers(billions), W = Weight(grams), L = Length(Cm), p = %

parameter	a1	a2	a3	a4	All
ISN	0	1.92	1.51	0.06	3.49
ISB	0	13.11	19.73	1.27	34.12
MeanW	0	6.82	13.08	20.86	9.77
MeanL	0	12.54	14.80	16.09	13.58
ISNp	0	55.05	43.20	1.75	100.00

