



**KVER HAFRANNSÓKNASTOFNUNAR**

Cruise report of acoustic assessment of the Iceland-  
East Greenland-Jan Mayen capelin stock in the  
autumn 2024

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HAFNARFJÖRÐUR – October 2024

# Upplýsingasíða

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## Titill:

Cruise report of acoustic assessment of the Iceland-East Greenland-Jan Mayen capelin stock in the autumn 2024

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## Ágrip:

Í þessari skýrslu eru kynntar helstu niðurstöður leiðangurs frá haustinu 2024 sem hefur það meginmarkmið að meta stærð loðnustofnins við Ísland, Austur-Grænland og Jan Mayen. Leiðangurinn fór fram 21. ágúst til 1. október á RS Árna Friðrikssyni og Polar Ammassak fyrir hönd Hafrannsóknastofnunar og RS Tarajoq fyrir hönd Grænlands. Stofnstærðarmælingar á loðnu byggðu á bergmálmælingum og sýnum frá flotvörputogum. Auk þess var ástand vistkerfisins rannsakað með sýnatökum á svifdýrumi með WP2 og bongo netum og umhverfis mælingum með sondu (CTD). Kynþroska loðnu var aðallega að utan finna íslenska landgrunnsins norðvestur af landinu. Í vestur hluta Grænlandssunds var kynþroska loðna í bland við ókynþroska, en útbreiðsla kynþroska loðnur náði ekki langt austur fyrir Grænlandssundið. Ekkert varð við loðnu vestan við Jan Mayen hrygginn eða Kolbeinseyjarhrygginn. Ókynþroska loðna fannst meðfram á landgrunni Grænlands með mesta þéttleika á suðvestur hluta svæðisins og í Grænlandssundi. Heildarfjöldi loðnu nam 74 milljörðum þar sem ókynþroska hlutinn var 58,5 milljarðar. Heildarlífmassi loðnu var 610 þúsund tonn og þar af var kynþroska 307 þúsund tonn.



**HAFRANNSÓKNASTOFNUN**

Rannsókn- og ráðgjafarstofnun hafs og vatna

**Abstract:**

*The report presents the main results of a survey aimed for assessing the stock size of Iceland-East Greenland-Jan Mayen capelin stock in the autumn 2024. The survey was conducted during 21 August to 1 October by the r/v Arni Fridriksson and f/v Polar Ammassak on behalf of Marine and Freshwater Research Institute in Iceland and r/v Tarajoq on behalf of Greenland Institute of Natural Resources. Abundance estimations were based on acoustic measurements and biological sampling with pelagic trawls. Moreover, the ecosystem conditions were studied with sampling of zooplankton by WP2 and bongo nets and environmental measurements with CTDs. Maturing capelin was mainly observed outside the Icelandic continental shelf off NW Iceland. In western part of Denmark Strait maturing capelin was mixed with immature capelin, but the distribution of maturing capelin reached not far east of Denmark Strait. Further, no capelin was found west of the Jan Mayen ridge or Kolbeinsey ridge. Immature capelin was found along the Greenlandic shelf, dominating in southwestern part of the survey area and Denmark Strait. The total number of capelin amounted to 74 billion where immature juveniles were 58.5 billion. The total biomass estimate was 610 000 tonnes of which about 307 000 tonnes were mature capelin.*

**Lykilorð:** loðna, capelin, *Mallotus villosus*, stofnmat, ráðgjöf.

**Undirskrift verkefnisstjóra:**



**Undirskrift forstöðumanns sviðs:**



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## Introduction

The report presents the main results of a survey aimed for assessing the stock size of Iceland-East Greenland-Jan Mayen capelin stock in the autumn 2024. It involves measuring mature and immature stock components at age 1 and older. The survey was conducted by the r/v Arni Fridriksson and f/v Polar Ammassak on behalf of Marine and Freshwater Research Institute (MFRI) in Iceland and r/v Tarajog on behalf of Greenland Institute of Natural Resources (GINR).

## Methods

### Survey area and conditions

The survey area was on and along the shelf edge off East Greenland from about 64°30' N towards about 72°15' N, also covering the Denmark Strait and the slope off northwest Iceland (Fig. 1). Early in the operation, r/v Arni Fridriksson had engine failure and had to quit participation in the project. Hence, the f/v Polar Ammassak was rented to finish the coverage. This caused time constraint along with limitations regarding hydrographic measurements and zooplankton sampling. The Iceland Sea, Kolbeinsey ridge and Greenland basin were only briefly scouted due to time constraints while due to same reasons hydrographic measurements were limited and zooplankton sampling was skipped onboard f/v Polar Ammassak.

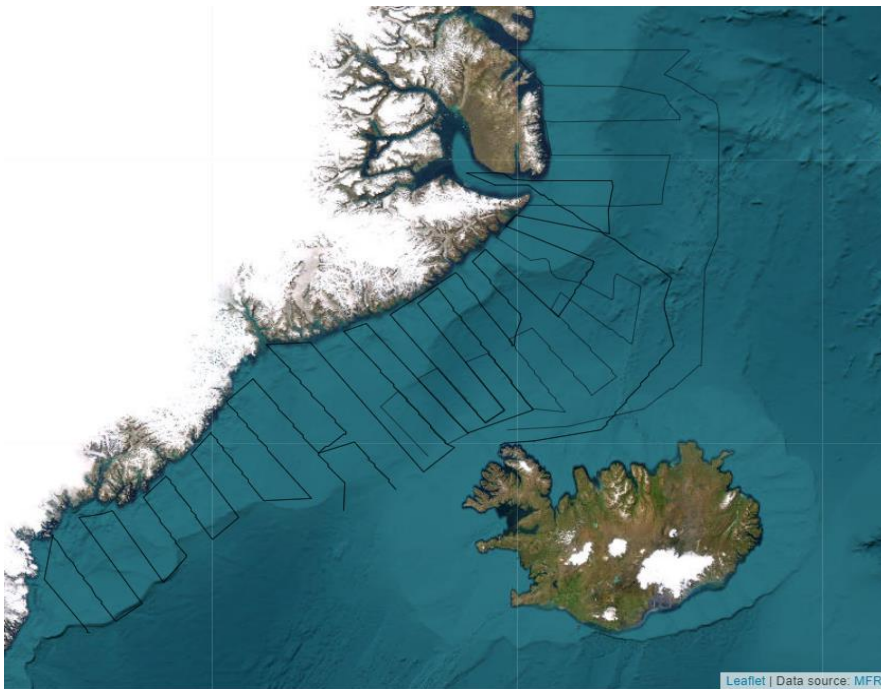


Figure 1. Survey tracks and sampling stations of the participating vessels. Type of sampling gear at each location shown by colour.

Tarajog departed from Hafnafjordur harbour 21 August, heading to the first capelin assessment transect at the southwest extent of the survey area. From there Tarajog followed

parallell transects covering the East-Greenland continental shelf from Umivik towards Denmark Strait. Due to bad weather, Tarajoq went into Isafjordur harbor on 2 September and the echosounders were calibrated the day after. Tarajoq departed for the second half of the survey on September 3. and continued the coverage of Denmark Strait.

Arni departed from Hafnarfjordur the 9. September and headed to Denmark Strait to operate in area that Tarajoq had not covered earlier due to weather. This was done while waiting for weather to calm down further east where Arni was planned to measure along transects in harmony with the coverage of Tarajoq. But due to engine failure, Arni went to harbor in Isafjordur to conduct engine repair. Unfortunately, the repair was not successful and the vessel had to head to home harbour in Hafnarfjordur and quit participation in the project. Arni arrived to Hafnarfjordur on 15 September.

While covering the regions from Kangerdlugssuaq fjord to Scoresby Tarajoq was delayed somewhat by bad weather. Tarajoq finished its last transect the 12 of September in the proximity of Scoresby Sound. The vessel had to seek shelter in Scoresby Sound fjord and did some observations there before heading south towards the shelf off north Iceland. Tarajoq finally arrived to harbor in Hafnarfjordur the 15 September.

Hence, there was urgent need for substitute vessels to immediately continue the measurements of Arni. The Greenlandic fishing vessel Polar Ammassak promptly shouldered the burden and made it possible to finish this important project and importantly the echosounder of the vessel was already calibrated. Polar Ammassak departed from Neskaupstadur harbor the 17 September and after some initial challenges that included trawl and computer replacements, the vessel arrived at the first transect the 19. September. Polar Ammassak began by repeating part of Tarajoq measurements in the southern Denmark Strait, where Tarajoq had observed mature capelin, and then continued eastwards. This repetition was due to lack of continued coverage of this maturing stock component caused by elimination of r/v Arni Fridriksson from the project. Polar Ammassak measured southeast Denmark Strait and the shelf slope north of Iceland towards Kolbeinsey ridge in calm weather and good conditions. From there the vessel covered areas along the Greenlandic shelf and shelf edges as continuance of Tarajoq coverage and ended by finishing its last transect by the mouth of Kong Oscar fjord on 27 September. By the end of the survey there were slight delays due to weather. Since there had not been any signs of capelin in large part of the northern survey area it was assumed that the northern extent of the capelin distribution had been reached and the vessel headed southwards over the East Greenland-Jan Mayen ridge and Iceland basin towards the Icelandic shelf just east of Kolbeinsey ridge. Then, heading to harbour in Hafnarfjordur where vessel arrived on 1 October.

In general, drift ice did not limit the coverage of the survey vessels although icebergs and a lack of benthic mapping occasionally affected routes and limited extension of transects towards the Greenlandic coast.

### Acoustic sampling

Acoustic data was sampled with Simrad EK80 echosounders at five frequencies on board the research vessel and with ES80 echosounder at two frequencies (only 38 kHz calibrated) on Polar Ammassak. The data were scrutinized by a scientist onboard the vessel and after survey using LSSS (version 2.17.0) 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 30 minutes latitude and 60 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.

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

$$C_L = \frac{C_{S_L} * \sigma_L}{\sum_L (C_L * \sigma_L)} * NASC * A$$

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

Where L is measured length,  $\sigma$  is backscattering cross-section, C is total number,  $C_s$  is number in sample, A is surface area and  $W_s$  is average weight in sample. Further, for ongoing project studying capelin backscatter (target strength), the backscatter was measured at chosen locations by a TS-probe (WBT-Tube) that was lowered to depths in the proximity of capelin schools.

### 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 of 36 pelagic trawl stations. Also, sex and maturity were estimated visually and the gonads from maturing capelin were weighted. Age was estimated from otoliths. Stomachs of 10 capelin were preserved on each station. Also 50 individual capelin were sampled on every second station for genetic analysis and further on every station 100



individuals in two size categories (above and below 14 cm) were sampled for fat content analysis.

WP2 zooplankton net:

Zooplankton was sampled on the research vessels by WP2 nets at depths down to 50 and 200 m at same location as CTD measurements if weather permitted. Only CTD measurements were made on Polar Ammassak on fixed transect stations. Although, Polar Ammassak had to skip some of the CTD stations on the transect outside Kong Oscar fjord due to weather.

Bongo nets:

Further Bongo samples were sampled diagonally down to 200 m at chosen transects on the research vessels but this sampling was not made on the fishing vessel.

Environmental measurements

Environmental parameters were measured at predefined locations by lowering a conductivity, temperature and depth meters (CTD) down to 500 m or down to bottom if shallower. This was done along defined transects with dense sampling at locations of interest often near shelf edges. More spread CTDs were also sampled in other regions to get general overall coverage. Further, a continuous surface measurements were registered along the track of r/v Arni Fridriksson.

WBT Tube acoustic back scattering measurements

Submersible echosounders (Simrad: WBT Tube) were brought for measuring back-scatter properties of capelin at depth, allowing for higher resolution measurements of individual targets. This was not accomplished during this survey because of the sudden elimination of r/v Arni Fridriksson from the project.

## Results and conclusions

Distribution of capelin

Maturing capelin was mainly observed outside the Icelandic continental shelf off Vestfirðir and NW Iceland. In western Denmark Strait maturing capelin was mixed with immature capelin, but mainly maturing capelin was found further east. Similar as last year, distribution of mature capelin was only reaching shortly east of Denmark Strait and that is again a drastic change from observations preceding last autumn, when mature capelin was found on or along the East Greenland continental shelf south, east and north of Scoresby. Further, no capelin was found by West Jan Mayen ridge or Kolbeinsey ridge. In general, there were no signs of any important quantities of capelin east of Kolbeinsey ridge nor along Icelandic shelf edges. Juveniles (0-group) of various species, including capelin (although not quantified) were observed along the continental shelf north and northwest of Iceland and along the southwestern coverage of the

Greenlandic shelf. Immature capelin was found along the Greenlandic shelf, dominating in southwestern part of the survey area and Denmark Strait. Overall, the distribution of maturing capelin was not reaching as far east in the autumn as in years before 2023. Figures 1, 2 and 3 show the cruise tracks, distribution and relative density of the capelin during the survey.

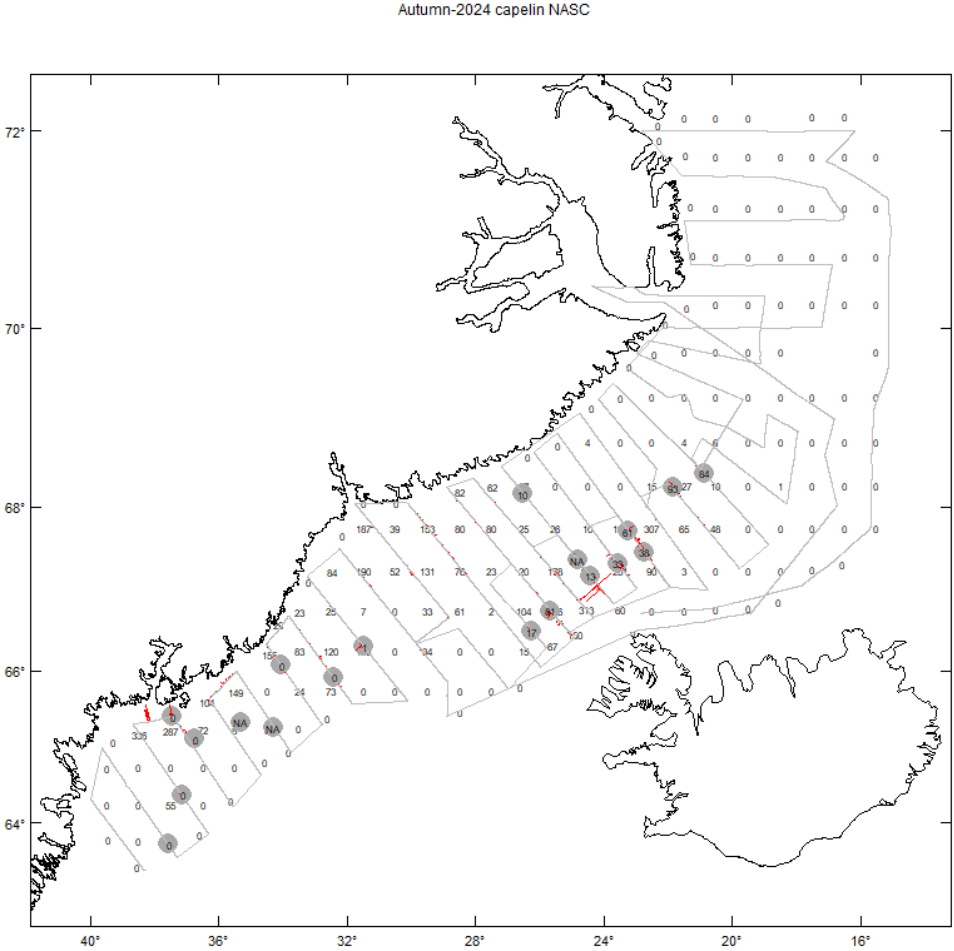


Figure 2. Capelin distribution as relative density of acoustic backscatter during the survey. Bars perpendicular to survey tracks show capelin acoustic backscatter as NASC per 0.1 nmi and the numbers shows average NASC within each rectangle. Tarajoq track light green, NASC dark green, Árne Friðriksson track cyan, NASC blue.

**Biomass and age composition of capelin**

Age and length disaggregated biomass is shown in Tables 1-6. The total number of capelin amounted to 74 billion where of the 1-group was about 57.4 billion. The total estimate of 2 group capelin was about 14.9 billion. The total biomass estimate was 610 000 tonnes of which about 320 000 tonnes were 2 years and older. About 1.2 % in numbers of the 1-group was estimated to be maturing to spawn, about 88.8 % of the 2 year old and 86.1 % of the 3 year old capelin appeared to be maturing. This gives about 307 000 tonnes of maturing 1 - 4 year

old capelin. Tables 1-6 give the age disaggregate biomass, numbers and weights of the capelin stock components.

The proportion mature at each trawl station is shown in Figure 4, mean length in Figure 5, mean whole body weight in Figure 6, mean age in Figure 7, and finally mean gonadosomatic index in Figure 8.

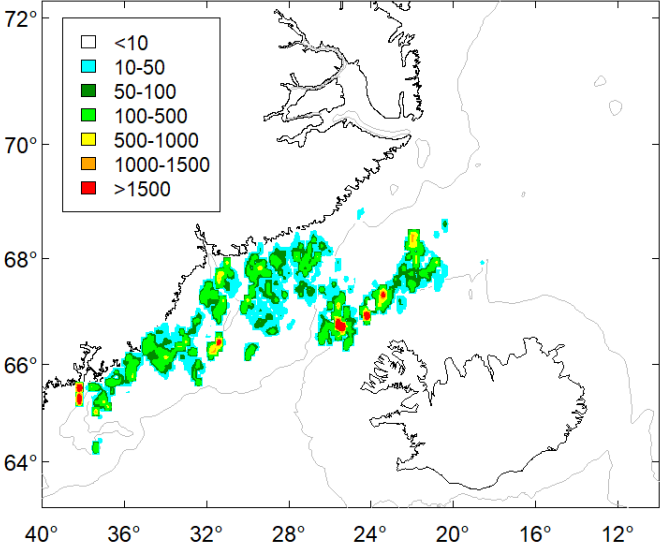


Figure 3. Capelin distribution as relative density of acoustic backscatter during the survey.

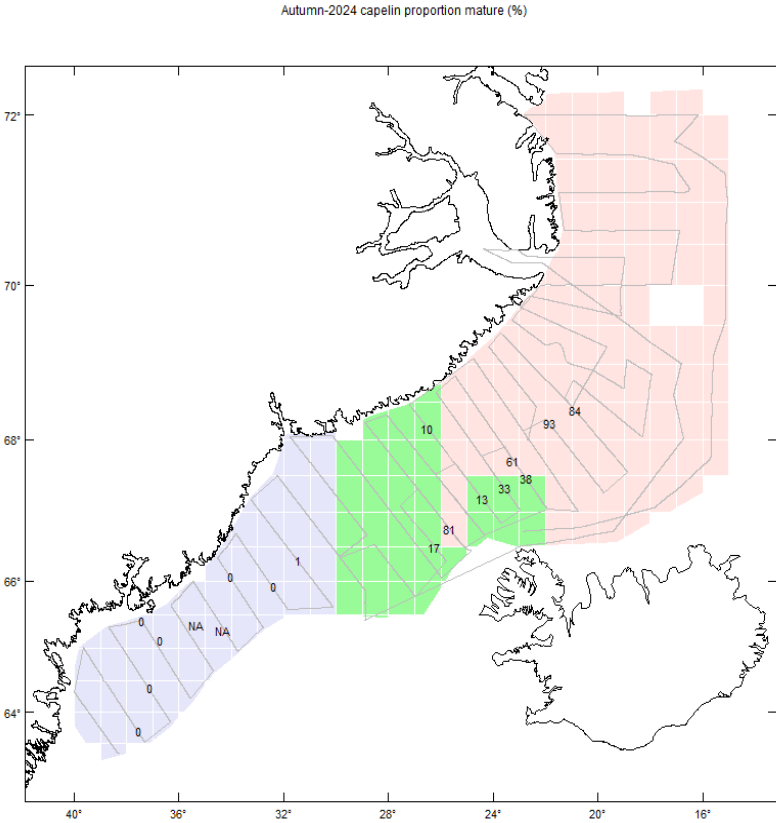


Figure 4. Proportion of mature capelin at each trawl station.

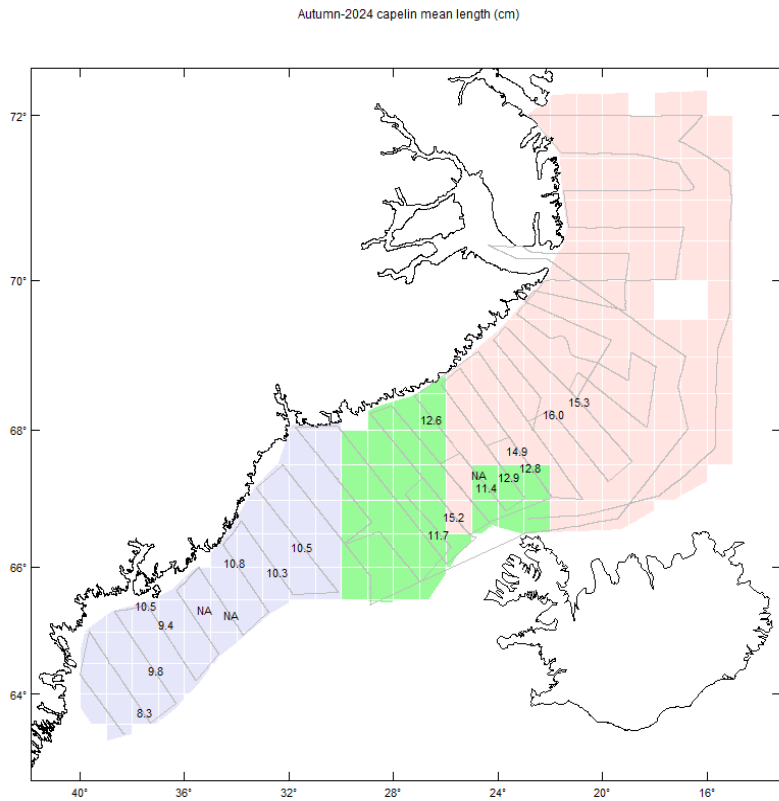


Figure 5. Mean length (cm) of capelin at each trawl station.

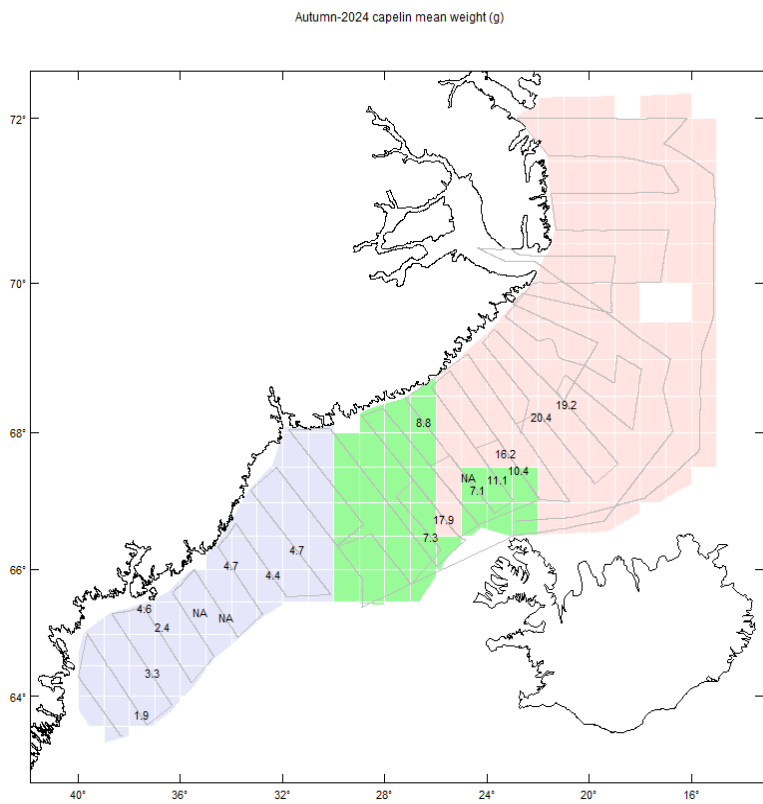


Figure 6. Mean weight (g) of capelin at each trawl station.



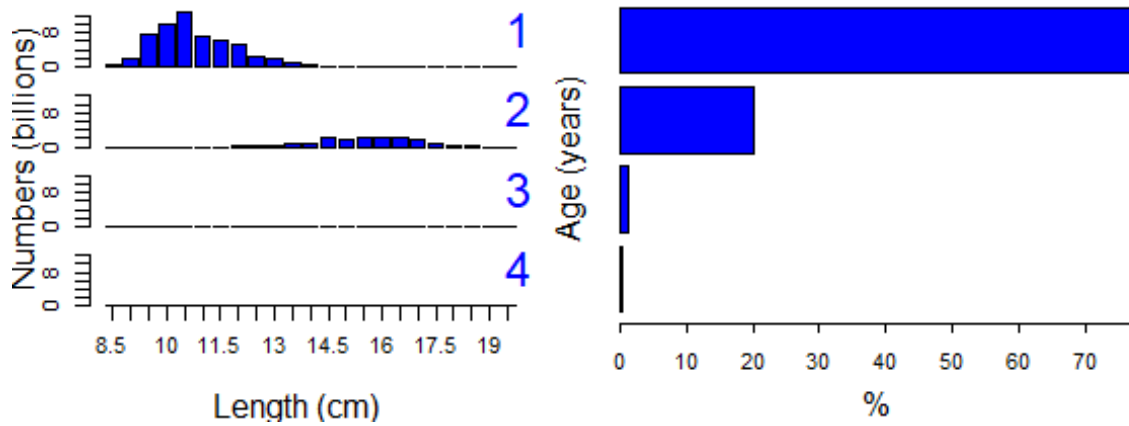
## Total stock

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 21 August – 27 September 2024. Mean weight is in grams

length	a1	a2	a3	a4	num.sampled	numbers	biomass	weight.mean
8.5	678.03	0.00	0.00	0.00	9	678.03	1386.80	2.05
9.0	1782.15	0.00	0.00	0.00	23	1782.15	4572.82	2.57
9.5	7439.00	0.00	0.00	0.00	96	7439.00	23612.39	3.17
10.0	10201.63	0.00	0.00	0.00	131	10201.63	38177.35	3.74
10.5	12679.69	0.00	0.00	0.00	176	12679.69	55593.70	4.38
11.0	7035.23	0.00	0.00	0.00	104	7035.23	36198.74	5.15
11.5	6284.64	0.00	0.00	0.00	104	6284.64	38098.37	6.06
12.0	5267.21	48.38	0.00	0.00	94	5315.59	37194.29	7.00
12.5	2605.15	137.19	0.00	0.00	54	2742.34	22279.52	8.12
13.0	1756.05	302.64	0.00	0.00	46	2058.69	19375.16	9.41
13.5	1163.14	749.24	48.38	0.00	45	1960.76	20786.63	10.60
14.0	440.98	709.94	88.82	0.00	34	1239.73	15253.14	12.30
14.5	0.00	2058.84	0.00	0.00	54	2058.84	29552.41	14.35
15.0	48.38	1619.01	48.38	0.00	47	1715.76	27351.87	15.94
15.5	0.00	2008.30	78.76	0.00	61	2087.06	38238.99	18.32
16.0	0.00	2310.94	139.51	0.00	70	2450.46	49909.18	20.37
16.5	0.00	2041.98	182.27	0.00	63	2224.25	51483.34	23.15
17.0	0.00	1613.38	151.89	157.51	55	1922.79	49058.33	25.51
17.5	0.00	843.83	60.76	30.38	29	934.96	26783.07	28.65
18.0	0.00	364.54	78.76	60.76	16	504.05	15099.10	29.96
18.5	0.00	91.13	60.76	48.38	6	200.27	5960.25	29.76
19.0	0.00	30.38	0.00	48.38	2	78.76	2563.47	32.55
19.5	0.00	0.00	48.38	0.00	1	48.38	1775.45	36.70

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	57.38	14.93	0.99	0.35	73.64
TSB	290.72	287.43	22.44	9.72	610.30
MeanW	5.07	19.25	22.74	28.15	8.29
MeanL	10.78	15.62	16.43	17.71	11.87
TSNp	77.92	20.27	1.34	0.47	100.00



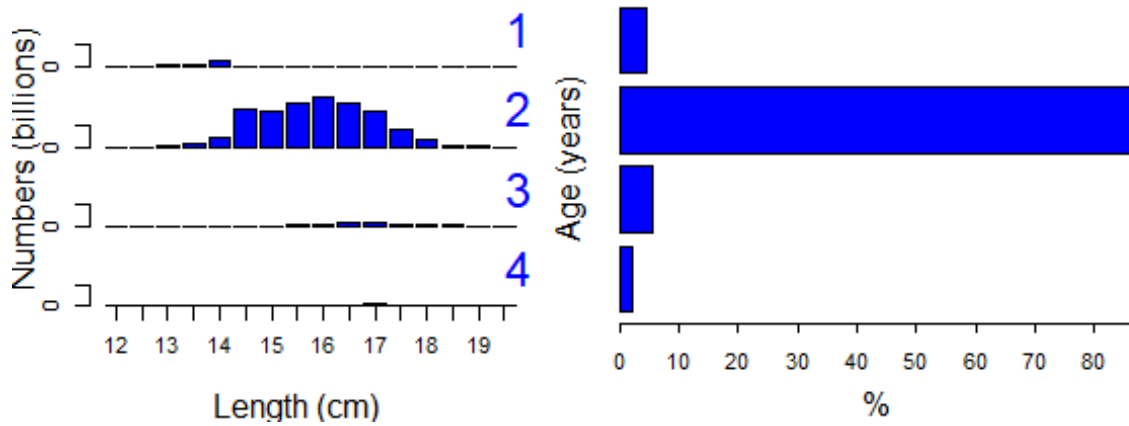
### Mature capelin

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 21 August – 27 September 2024. Mean weight is in grams.

length	a1	a2	a3	a4	num.sampled	numbers	biomass	weight.mean
12.0	48.38	0.00	0.00	0.00	11	48.38	387.02	8.00
12.5	48.38	0.00	0.00	0.00	11	48.38	353.16	7.30
13.0	127.13	48.38	0.00	0.00	16	175.51	1692.71	9.64
13.5	139.51	187.89	0.00	0.00	25	327.40	3761.24	11.49
14.0	291.40	418.54	0.00	0.00	31	709.94	8856.66	12.48
14.5	0.00	1733.76	0.00	0.00	53	1733.76	24906.74	14.37
15.0	48.38	1619.01	48.38	0.00	47	1715.76	27351.87	15.94
15.5	0.00	1977.92	78.76	0.00	61	2056.68	37817.34	18.39
16.0	0.00	2280.57	139.51	0.00	70	2420.08	49392.15	20.41
16.5	0.00	2041.98	182.27	0.00	63	2224.25	51483.34	23.15
17.0	0.00	1613.38	151.89	157.51	55	1922.79	49058.33	25.51
17.5	0.00	843.83	60.76	30.38	29	934.96	26783.07	28.65
18.0	0.00	364.54	78.76	60.76	16	504.05	15099.10	29.96
18.5	0.00	91.13	60.76	48.38	6	200.27	5960.25	29.76
19.0	0.00	30.38	0.00	48.38	2	78.76	2563.47	32.55
19.5	0.00	0.00	48.38	0.00	1	48.38	1775.45	36.70

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	0.70	13.25	0.85	0.35	15.15
SSB	7.98	268.70	20.84	9.72	307.24
MeanW	11.34	20.28	24.54	28.15	20.28
MeanL	13.55	15.87	16.85	17.71	15.86
SSNp	4.64	87.47	5.61	2.28	100.00



### Immature capelin

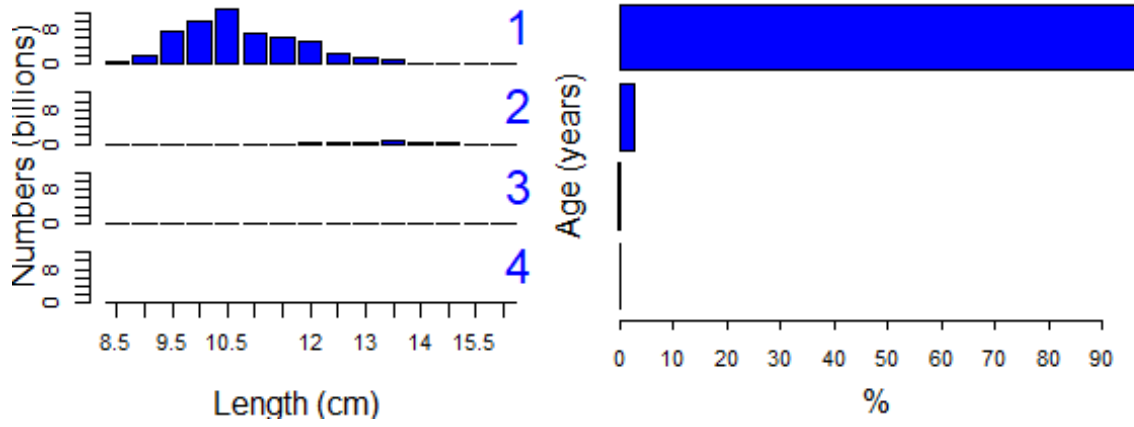
Table 5. Estimated stock size of the Iceland-Greenland-Jan Mayen capelin immature stock component in numbers (millions) by age (years) and length (cm), and biomass (thous. tonnes) from the acoustic surveys in 21 August – 27 September 2024. Mean weight is in grams.

length	a				num.sampled	numbers	biomass	weight.mean
	a1	a2	a3	4				
8.5	678.03	0.00	0.00	0	9	678.03	1386.80	2.05
9.0	1782.15	0.00	0.00	0	23	1782.15	4572.82	2.57
9.5	7439.00	0.00	0.00	0	96	7439.00	23612.39	3.17
10.0	10201.63	0.00	0.00	0	131	10201.63	38177.35	3.74
10.5	12679.69	0.00	0.00	0	176	12679.69	55593.70	4.38
11.0	7035.23	0.00	0.00	0	104	7035.23	36198.74	5.15
11.5	6284.64	0.00	0.00	0	104	6284.64	38098.37	6.06
12.0	5218.84	48.38	0.00	0	94	5267.21	36807.27	6.99
12.5	2556.77	137.19	0.00	0	54	2693.97	21926.36	8.14
13.0	1628.91	254.27	0.00	0	46	1883.18	17682.46	9.39
13.5	1023.63	561.35	48.38	0	45	1633.36	17025.39	10.42
14.0	149.57	291.40	88.82	0	30	529.79	6396.48	12.07
14.5	0.00	325.08	0.00	0	34	325.08	4645.67	14.29
15.5	0.00	30.38	0.00	0	9	30.38	421.65	13.88
16.0	0.00	30.38	0.00	0	14	30.38	517.04	17.02

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	56.68	1.68	0.14	0	58.49
ISB	282.69	18.80	1.58	0	303.06
MeanW	4.99	11.20	11.49	0	5.18
MeanL	10.74	13.66	13.82	0	10.84
ISNp	96.90	2.87	0.23	0	100.00





## References

ICES. 2023a. Benchmark workshop on capelin (WKCAPELIN). ICES Scientific Reports. 5:62. 282 pp. [https://ices-](https://ices-library.figshare.com/articles/report/Benchmark_workshop_on_capelin_WKCAPELIN_/23260388)

[library.figshare.com/articles/report/Benchmark\\_workshop\\_on\\_capelin\\_WKCAPELIN\\_/23260388](https://ices-library.figshare.com/articles/report/Benchmark_workshop_on_capelin_WKCAPELIN_/23260388)

ICES. 2023b. Stock annex: Capelin (*Mallotus villosus*) in subareas 5 and 14 and Division 2.a west of 5°W (Iceland and Faroes grounds, East Greenland, Jan Mayen area). ICES Stock Annexes. Report. <https://doi.org/10.17895/ices.pub.23600094>