Cruise: A12-2017
Period: 06.09.-29.09. 2017.

Cruise: B13-2017
Period: 21.09.-09.10. 2017.

Preliminary cruise report:
Acoustic assessment of the Iceland-Greenland-Jan Mayen capelin stock in autumn 2017.

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Objective

The main objective of the survey was acoustic assessment of the capelin stock in the Iceland, East Greenland and Jan Mayen area, measuring mature and immature stock components at age 1 and older. The survey was conducted on the research vessels Arni Fridriksson and Bjarni Saemundsson.

Methods

Survey area and conditions:

The survey area was on and along the shelf edge off East Greenland from about 74° 55´N to about 64°50´ N, also covering the Greenland Strait and the slope off west, north and east Iceland. The Iceland Sea, south, west and north of Jan Mayen was also surveyed.

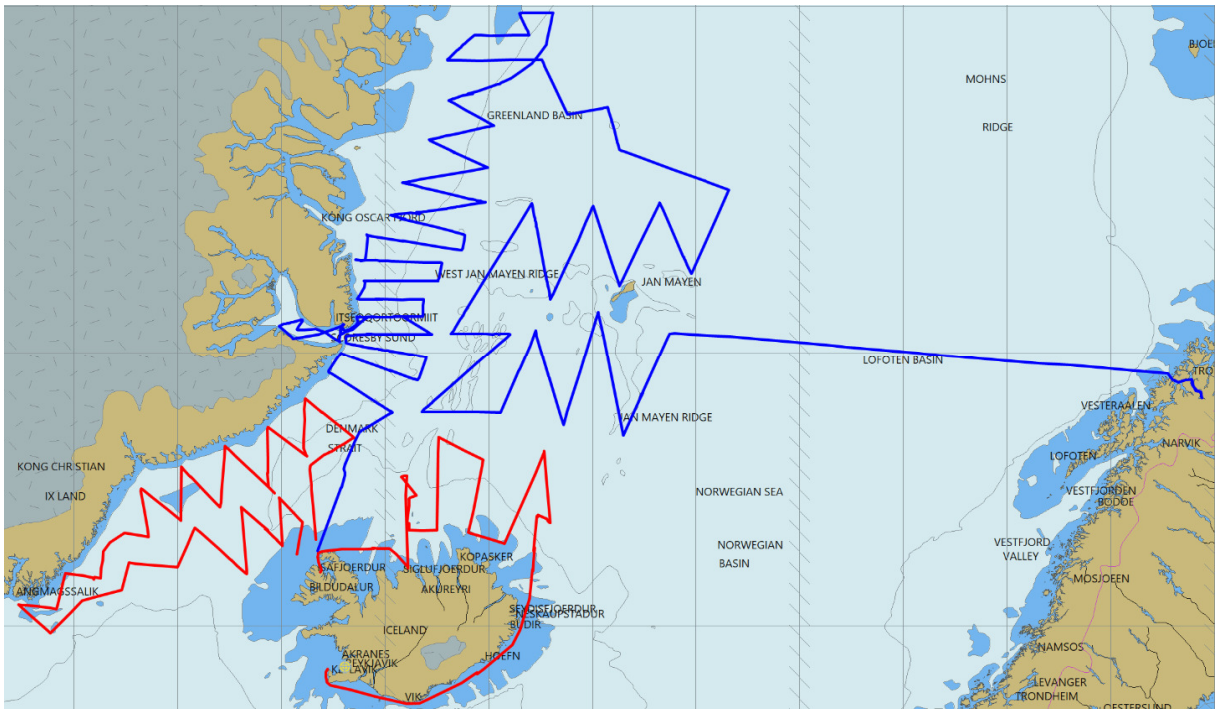

Figure 1 Routes of the research vessels; Arni Fridriksson (blue), Bjarni Saemundsson (red).

The 06th of September the research vessel Arni Fridriksson started the survey from Tromsö in Norway after finsihing participation in a Norwegian project. The first day the vessel sailed to Balsfjord in Norway for calibration of the echosounders. Calibration data was stored for later analysis while calibration settings from previous calibration were not changed. Bjarni Saemundsson was not calibrated during the survey and should be recalibrated at first opportunity after the survey. Bjarni Saemundsson was supposed to start the survey on the 11th of September, but due to engine failure the vessel could not start until the 21. September. Bjarni started in the eastern part of the Icelandic shelf area and measured westward along the Icelandic shelf crossing the Kolbeinsey Ridge (red track lines on Fig. 1) but Arni Fridriksson scouted through the area in Iceland Sea south, west and north of Jan Mayen before heading to the northern most part of the survey area at about 74° 19N where some minor capelin scatter was observed and trawling caught some capelin, hence the vessel cruised further north towards 74° 55' N without observing more capelin. Then Arni surveyed southwards along the Est-Greenlandic shelf and shelf edges (blue track lines on Fig. 1).

The only effects of ice were when Bjarni Saemundsson could not go as close to the Greenlandic coast as planed in the region between Kap Gustav Holm and Kap Hammer due to drift ice and icebergs. In Scoresby icebergs altered transect lines but did not prevent measurements. There were no hindrances due to ice in other parts of the survey area.

There were occasional delays and halts due to weather and because of a heavy storm Arni had to seek shelter in Scoresby for one day and for same reason Bjarni had to stop northeast of Langanes peninsula the 23. And 24. September. The 27. September Bjarni had to abandon survey tracks in Kolbeinsey Ridge areas and head to nearest harbour, in Siglufjordur, with injured crew member. The 28. September Arni had serious engine failure and had to sail to harbour (arrived to Reykjavik the 29. September) and did not participate further in this project. Bjarni continued and finished the acoustic measurements by covering Denmark Strait and the area westward towards Angmagsalik. Bjarni had repeated engine problems during the end of the survey.

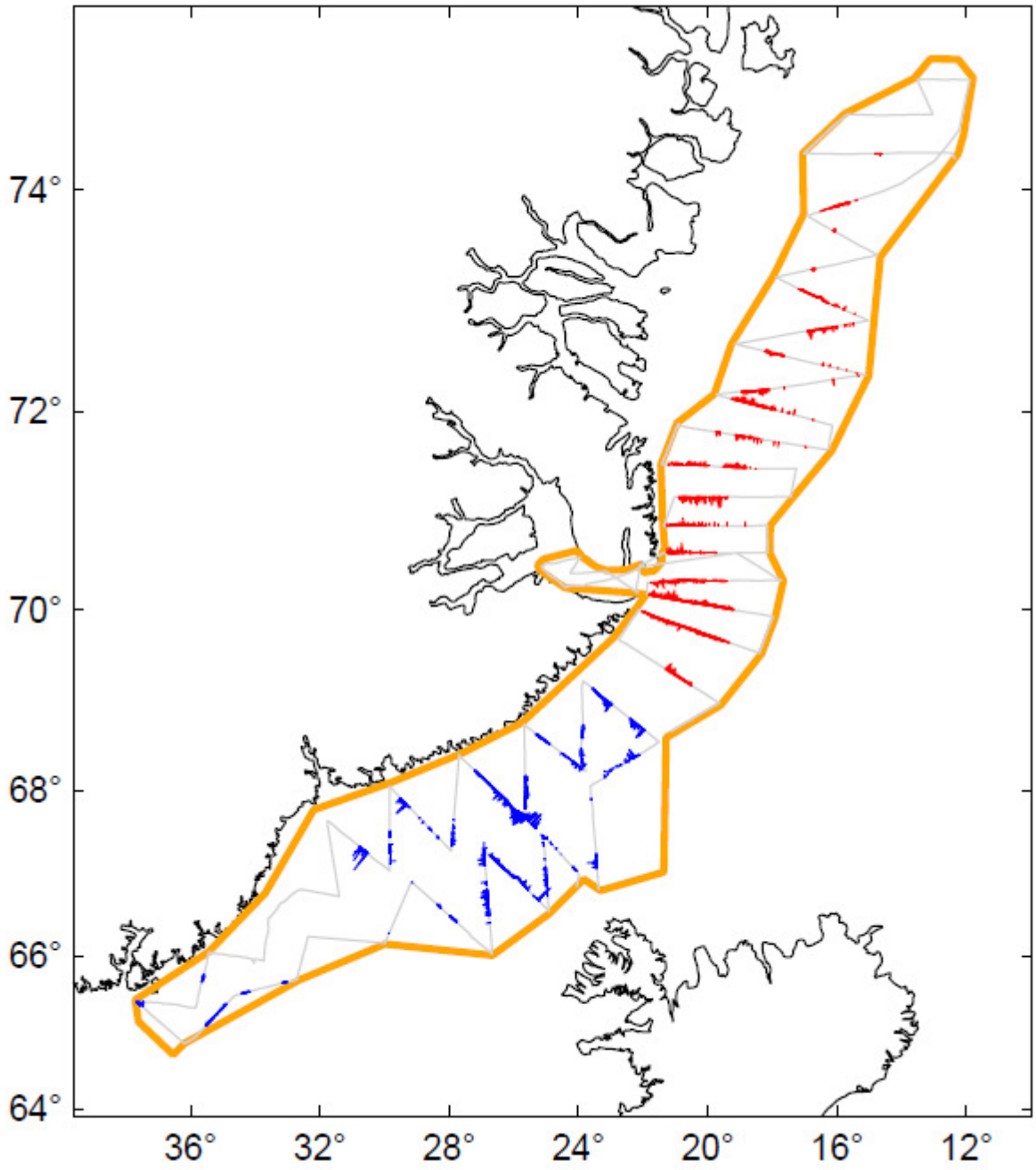

Figure 2 Capelin distribution as relative density of acoustic backscatter during the survey. Survey tracks of R/V Arni Fridriksson and R/V Bjarni Saemundsson are shown as black transect lines.

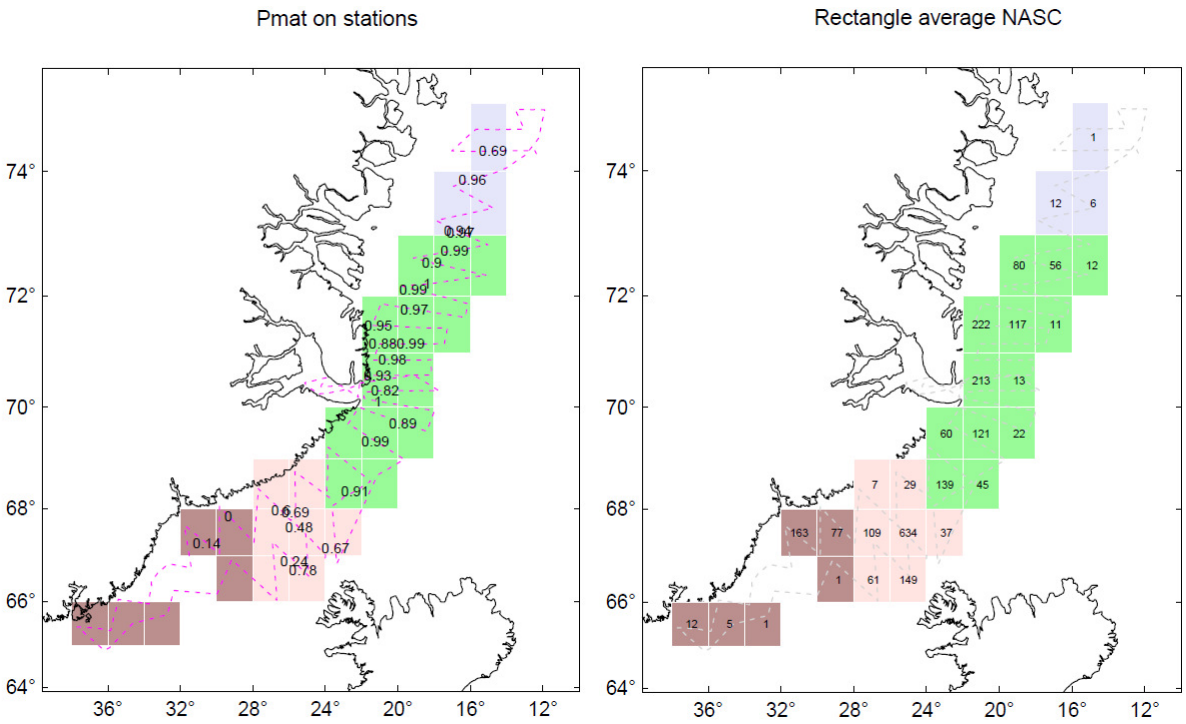

Figure 3 Region allocations by color. Maturity proportion at each trawl station and average NASC within each rectangle.

Acoustic sampling:

Acoustic data was sampled with Simrad EK60 transducer at four frequencies in Arni Fridriksson (18, 38, 120 and 200 kHz) and at three frequencies (18, 38 and 120 kHz) in Bjarni Saemundsson. The 38 kHz data were scrutinized using LSSS (version 2.1.0) software where capelin backscatter was defined and its Nautical Area Scattering Coefficient (NASC) in S_A units (m^2/nmi^2) calculated at 0.1 nmi integration intervals. EchoView live viewing was run simultaneously for an alternative view of the recordings. The acoustic data was scrutinized by a scientist on-board each vessel. Then, average NASC within squares of 60 minutes latitude and 120 minutes longitude was calculated.

Abundance in numbers was estimated using a length dependent target strength (TS; in dB re $1m^2$)

$$TS = 19.1 \log(L_{+0.25}) - 74.5$$

Where $L_{+0.25}$ is total length (cm) added by 0.25 cm because of the design of the measuring board (0.5 cm interval in front of the grid). For each length interval within the length distribution of capelin in the samples the following parameters were calculated: backscattering proportion, number and weight.

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

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

$$W_L = C_L * \overline{Ws_L}$$

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

Biological sampling:

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, resulting in 2715 measured capelin in total. Also, sex and maturity were estimated visually and the roe from maturing females were weighted. Age was estimated from otoliths.
Gonads of 12 capelin were sampled in formaldehyde and imaged for gonad development study, stomachs of 50 capelin were sampled in ethanol for a trophic study and also 14 eDNA samples were filtered from seawater at various depths at 7 locations to facilitate the development of methods for screening for capelin DNA in the seawater samples. Four marine mammal and seabird observers were on-board each vessel until 29th September.

Environmental measurements:

Conductivity, Temperature and depth (CTD) measurements were made at 83 locations and surface temperature and salinity were measured continuously during the survey. Chlorophyll was filtered from surface seawater around noon.

Results

a) Distribution

Capelin schools were observed mainly along the East Greenlandic continental shelf in the Scoresby area and in Denmark Strait while no capelin was found in Iceland Sea, around Jan Mayen or along the continental shelf off northern Iceland (Fig. 1). Immature capelin was found in rather low numbers, or 26.1 billion whereof 24.6 billion belonged to capelin at age 1. Immature capelin was generally found in the southwestern part of the surveyed area but further north along the Greenland shelf older, maturing capelin predominated. The distribution of capelin was westerly as in recent years and mature capelin was found closer to the Greenlandic coast than before. Figure 2 shows the cruise tracks, distribution and relative density of the capelin during the survey.

b) Biomass and age composition

Age and length disaggregated biomass is shown in table 1. The total number of capelin amounted to 68 billion whereof the 1-group was about 25.8 billion. The total estimate of 2-group capelin was about 37 billion. The total biomass estimate was 1 164 000 tonnes of which about 952 000 tonnes were 2 years and older. About 4.8 % in numbers of the 1- group was estimated to be maturing to spawn, about 96 % of the 2 year old, 99.7 % of the 3 year old and all 4 year old capelin appeared to be maturing. This gives 945 000 tonnes of maturing 1 - 4 year old capelin. In Table 1 is shown the age disaggregate biomass, numbers and weights of the capelin.

Table 1 Estimated stock size of Iceland-Greenland-Jan Mayen capelin stock in numbers by age and length, and biomass from the acoustic survey in 06. September – 9. October 2017. Summary statistics for the total stock and the maturing and immature part of stock are given at the bottom of the table.

	Length	Numbers at Age (10^9)				Numbers	Biomass	Mean
	(cm)	1	2	3	4	(10^9)	(10^3 t)	weight (g)
	9.5	0.06	0.00	0.00	0.00	0.06	0.19	3.2
	10	0.18	0.00	0.00	0.00	0.18	0.62	3.5
	10.5	0.99	0.00	0.00	0.00	0.99	4.29	4.4
	11	1.69	0.00	0.00	0.00	1.69	8.42	5.0
	11.5	3.30	0.00	0.00	0.00	3.30	19.52	5.9
	12	5.35	0.00	0.00	0.00	5.35	38.29	7.2
	12.5	5.30	0.00	0.00	0.00	5.30	43.76	8.3
	13	4.27	0.14	0.00	0.00	4.42	41.87	9.5
	13.5	2.62	0.10	0.00	0.00	2.72	29.68	10.9
	14	1.35	0.72	0.00	0.00	2.07	26.63	12.9
	14.5	0.58	1.61	0.00	0.00	2.19	30.40	13.9
	15	0.11	3.41	0.02	0.00	3.54	57.82	16.3
	15.5	0.05	5.26	0.20	0.00	5.52	100.27	18.2
	16	0.00	7.29	0.49	0.00	7.78	156.82	20.2
	16.5	0.00	6.93	0.50	0.00	7.43	168.49	22.7
	17	0.00	5.27	1.18	0.00	6.45	164.26	25.5
	17.5	0.00	3.51	1.12	0.00	4.64	129.52	27.9
	18	0.00	1.92	0.89	0.02	2.82	87.36	31.0
	18.5	0.00	0.63	0.60	0.03	1.27	43.47	34.3
	19	0.00	0.19	0.12	0.00	0.31	11.50	36.9
	19.5	0.00	0.00	0.02	0.00	0.02	0.57	37.0
TSN (10^9)		25.84	37.00	5.13	0.05	68.0		
TSB (10^3 t)		212	810	140	1.5		1163.74	
Mean W (g)		8.2	21.9	27.2	33.2			17.1
Mean L (cm)	14.4	12.4	16.3	17.3	18.3			
%TSN		38.0	54.4	7.5	0.1			
SSN (10^9)		1.3	35.5	5.1	0.05	41.9		
SSB (10^3 t)		15.8	788.4	139.3	1.5		945.1	
SMean W (g)		12.6	22.2	27.2	33.2			22.5
SMean L (cm)	16.4	13.8	16.3	17.3	18.3			
%SSN		3.0	84.7	12.2	0.1			
ISN (10^9)		24.6	1.5	0.0	0.0	26.1		
ISB (10^3 t)		196.2	22.1	0.3	0.0		218.6	
IMean W (g)		8.0	15.0	22.3				8.4
IMean L (cm)	12.5	12.3	14.9	17.0				
%ISN		94.3	5.6	0.1	0.0			