Iceland-East Greenland-Jan Mayen Capelin autumn survey manual 2022

DRAFT

Surveys:

A10-2022

and

Tokt6-Tarajoq-2022

Project planning group:

Sigurður Þór Jónsson, Sigurvin Bjarnason, Hafró

and

Teunis Jansen, Lars Heilmann, GINR

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Aim of survey

The main purpose of the survey is acoustic estimation of stock size and distribution of mature and immature capelin, age groups 1 and older in Iceland, East Greenland and Jan Mayen waters. In parallel it is endeavoured to utilize the survey to gain further information on capelin biology and ecosystem couplings to biological communities and the physical environment in the area.

Survey summary

The survey area extends along the East Greenland shelf break from 63°N to 75° N, over the Denmark Strait and along the shelf break north of the Westfjords peninsula and North Iceland, east to ~12°W meridian. Figure 2 shows draft survey transects, but note they are likely to change as the weather, drift ice and the distribution of the capelin have to be taken into account during the execution of the survey. According to this plan (see Table 1) total sailed distance will be approx. 8200 nmi.

Table 1 Survey summary

	Start	**Exchange**	**End**	**Days**	**Distance (nmi)**	**Notes**
Tarajoq	27. aug	8. sep	20. sep	24	5200	Possible savings using Ísafjörður
Arni Friðriksson	5. Sep		21. Sep	16	3200	Heavier fixed station load
			Total	**40**	**8200**	

Areal coverage

For the purpose of acoustic abundance estimates of this migrating stock a continuous coverage with minimal delays between transects is preferred. Based on observed capelin distribution in recent years and considering oceanography the survey coverage is planned with priorities as described on Figure 1. This year 3d priority regions will only get measured if there will be remaining time at end of survey or if conditions will favour it during a halt of measurements in higher priority areas due to bad weather. The northern Icelandic shelf has higher priority this year due to capelin observations in May and July.

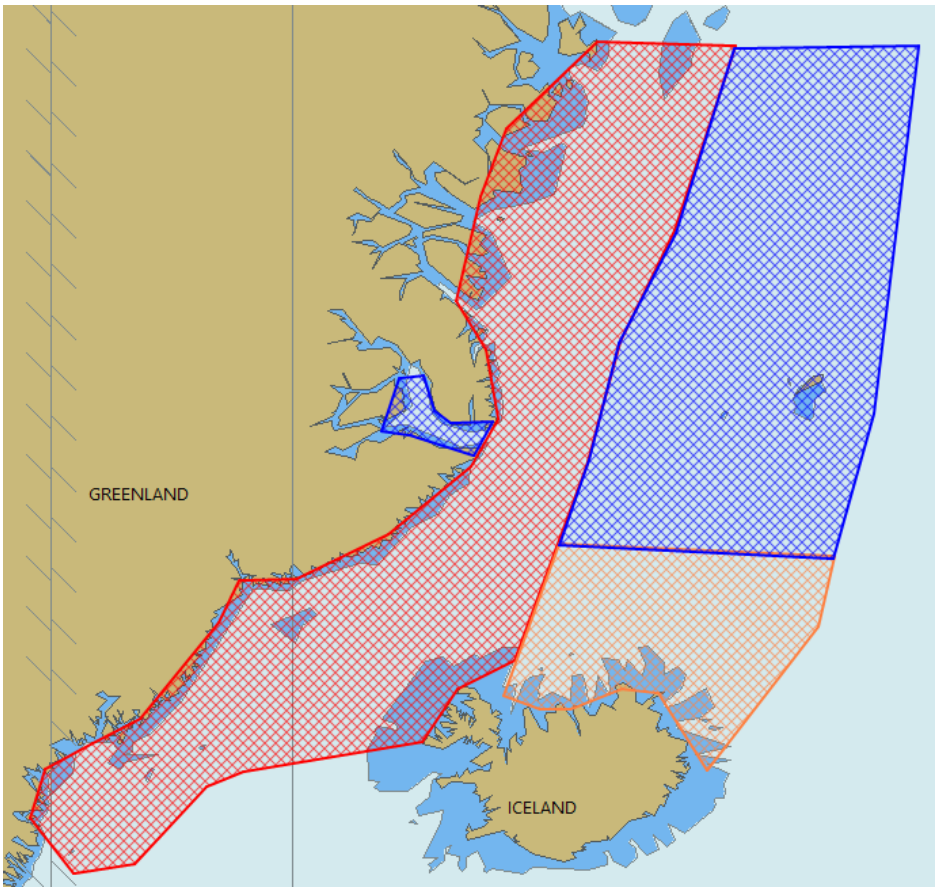

Figure 1 Regions covered by the capelin autumn survey. Priorities of the regions: Red = 1st priority, Orange= 2nd priority, Blue = 3d priority.

Survey design and vessel allocations

Tarajoq will depart from Hafnarfjordur on august 27th and start with covering the southwestern part of the survey area. Tarajoq will have a personnel change in Hafnafjordur on the 8th of September at which time Arni will have departed from Hafnafjordur harbour (on Sep 5th) and continue in the west where Tarajoq leaves off. After the personnel change, both vessels will work in tandem, covering the main region along the east coast of Greenland to the north Tarajoq going furthest north, while Árni will turn south to cover the north Icelandic shelf break, as shown in Figure 2. Secondary regions will be covered as time permits, but weather and conditions may lead to a different approach.

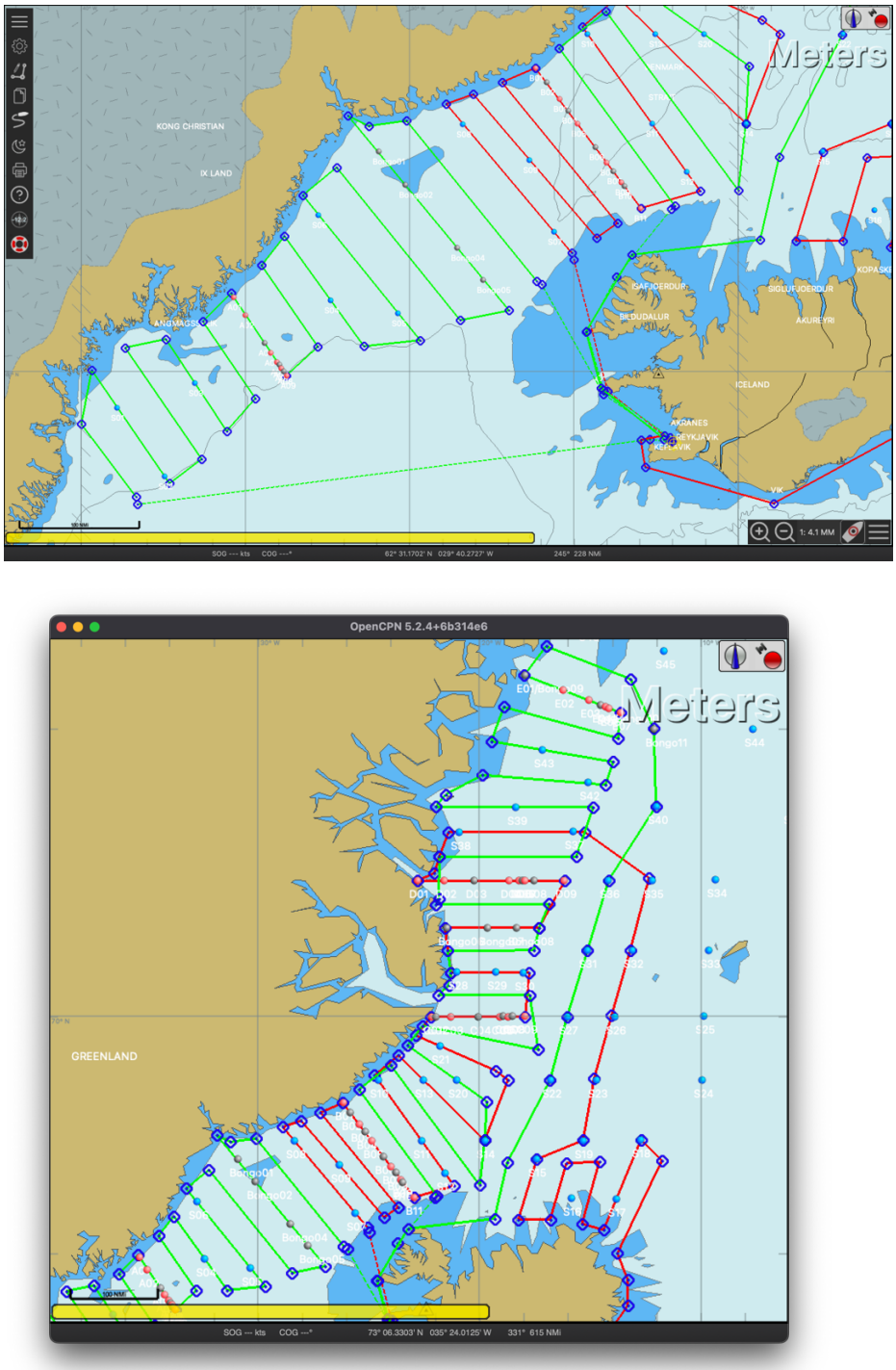

Figure 2 Suggested density of survey transects within each region, Tarajoq green, Árni red.

Research/operation licenses for the vessels

Research licenses need to be applied for in a timely manner. Árni will need licenses in Greenlandic, Jan Mayen and Icelandic regions. Tarajoq will need licenses in Greenlandic and Icelandic regions. Vessels will need to have license all the way to coast, at least in Greenlandic waters.

Survey tracking

Real time mapping of the tracks of the vessels has been valuable for collaborators and as a public outreach. We have been using the VMS and AIS systems to track the vessels, but to make that possible, authorities (i.e. coast guard) and vessel owners need to agree on sharing the location data.

Data collection

Sampling overview

Figure 3 Sampling stations. Red dots = Main transect CTDs/WP2, Gray dots = CTDs/WP2/Bongo, Blue dots = Spread CTDs/WP2. NOTE transect plan from 2021.

Station information

For every station one station sheet should be filled out. The chief scientist oversees the stations sheets and enters the information into SeaScale. If something goes wrong during trawling it should be noted and a decision taken on whether or not to trawl again. If a station is repeated a new station is created with a new station ID / number.

Variable	Description
Survey ID	E.g. 'A9' for Árni Friðriksson, ninth survey of year.
Year	4 digits, e.g. '2019'.
Station	Running number.
Ship ID	4 digits, e.g. 2350 for Árni Friðriksson.
Date	Day and month, 'dd/mm'.
Gear code	Gear code in Hafró gear coding system.
Mesh size	Mesh size in codend.
Sweep length	Length of sweeps in fathoms.
Gear ID	ID of the specific trawl used.
Total catch	Total catch in kg.
Position of setting and hauling in the trawl	Latitude and longitude in degrees, minutes and decimal minutes (DD°MM.mm) according to GPS positioning.
Time[1]	Time (HH:MM) at start and end of tow.
Tow direction	Tow direction in degrees. Average during tow.
Bottom depth	Bottom depth in meters.
Towing depth	Towing depth (depth of trawl headline) in meters.
Vertical opening	Vertical opening of the trawl in meters. Average for the tow according to gear sensors.
Door spread	Door spread in meters. Average for the tow according to gear sensors.
Wire length	Length of wire given out on the tow in fathoms. Average for the tow.
Tow length	Tow length in nautical miles according to track on GPS.
Tow duration	Duration of tow in minutes. Time from start to end of tow (i.e. at towing depth).

[1] At start and end of trawl haul. Start: when the trawl has reached towing depth. End: when trawl is hauled back from towing depth.

Tow speed	Tow speed (nmi h^{-1}) according to tow length and tow duration.

Trawl samples

Towing will be undertaken with a Gloria Widebody or Multpelt pelagic trawl with a capelin codend on r/v Árni Friðriksson and a Multpelt 416 on Tarajoq as acoustic registrations indicate and the acoustics watch decides. Trawl samples are very important during interpretation of the acoustics and estimating the composition of the stock and it is therefore important to collect sufficient number of trawl samples. Situations can arise where separate acoustic registrations at different depths give occasion for trawling twice in the same location to get separate samples.

Paragraph from Teunis regarding trawl operations:

The capelin trawl on Tarajoq performed well at most depths when the upper hatch on the doors were opened and the rest were closed (must be set at beginning of survey because it differs from the mackerel survey operation). The trawl eye should be on the lower line, not the headline.

Fish biology

Researchers work up samples from trawl catches right away, towing is undertaken around the clock. All catch is taken below deck, weighed in batches in the trough weight (~85 kg) on-board r/v Árni Friðriksson, but on-board r/v Tarajoq volumetry in trough or baskets. A capelin sample is taken in a bucket in the middle of the catch, or at least not the first or last part of the catch. The whole catch is sorted by species in co-operation between deck hands and researchers, generally this entails sorting a small amount of other catch from the capelin. Catch of each species is weighted and measured, by-catch species are measured and/or sampled for otoliths according to sampling table. Age determination of capelin is done on-board if possible. Instructions for capelin otolith extraction can be found in quality handbook, section 4.02. Note that the order of fish must be random. Length, ungutted weight, gonad weight (maturity stage 3 and above, both sexes), sex and maturity is collected on fish selected for otolith extraction.

Lumpfish: Sample one female and one male on each station, determine length, ungutted weight, sex, maturity, gonad weight, liver weight, gutted weight and extract otoliths. Measure length and determine sex (sexed length measurement) of up to 20 fish per station. All lumpfish sex and maturity allocation should be made by visual examination of the gonads as external distinction can be difficult.

Enmeshed capelin shall be shaken from the trawl, which will be examined by the researcher with regard to proportions of juvenile and 0-group capelin. Length measurement taken from 50 0-group capelin to the nearest mm, registered as species 931. Total weight of the 50 capelin 0-group/larvae shall also be recorded. Also, about 100 individuals of 0-group capelin should be preserved in ethanol for the project ‘Distribution, origin and fate of capelin larvae’.

Species	No length measures	No otoliths	Stomachs	Frozen for DNA	Frozen for fat measure	Unit	Measuring board
Capelin	100[1]	100	10	50[3]	2x50[4]	1 mm	mm board
Capelin 0-group	50					1 mm	mm board/paper
Polar cod	100	20	10			1mm	mm board
Herring	150	50				1 cm	Rounding down to cm below (Icelandic Herring board)
Blue whiting	100	25				1 cm	Rounding down to cm below (Icelandic Herring board)
Mackerel	100	25				1 cm	Rounding down to cm below (Icelandic Herring board)
Lumpfish	20[2]	1 male + 1 female				1 cm	Standard fish board (MFRI) Rounding down to cm below (GINR)
Myctophids and pearlsides	50					1 mm	mm board/paper

[1] Always pinched tail length (Hansen et. al 2018).

[2] Sexed length measurement.

[3] Every second trawl station.

[4] 50 capelin > 14cm and 50 capelin < 14cm.

Other	100					1 cm, generally	Standard fish board (MFRI) Rounding down to cm below (GINR)

Acoustic measurements

Acoustic measurements are conducted along predetermined transects/sections and it is important to keep the correct heading and it is expressly forbidden to turn off the track towards schools while on transect. After taking a trawl sample, acoustic measurements should start again at the position reached before going off transect for the haul. Usually, the vessel turns back to tow on registrations according to decisions made by the acoustics watch. Towing in the transect direction generally does not give a valid measurement. It is necessary to keep a good acoustics watch logbook. Trawl sampling and other events during acoustic surveying should be recorded in a digital acoustics watch logbook. Vessel track shall be logged continuously with OpenCPN at the acoustics watch, in addition every station shall be marked. It is useful if such waypoints contain a link to information about each station, e.g. CTD-info or trawl sample composition. Tracks and waypoints shall be saved regularly in gpx-format (Export as GPX) or at least once every 24 hours and shared within collaborators.

Acoustic data are collected to 500 m depth on the 'narrow band' frequencies on offer by the acoustic instrumentation of the vessel (see table). Raw data (.raw) are saved and acoustic registrations on 38 kHz interpreted as capelin are saved as back-scatter (NASC, Nautical Area Scattering Coefficient in sA-units (m^2/nmi^2)) with -70 dB lower threshold in 0.1 nmi integration intervals in the LSSS post-processing program.

	Arni Friðriksson	Tarajoq
Echo sounder	Simrad EK80	Simrad EK80
Frequency (kHz)	**38**, 18, 70, 120, 200	18,**38**, 70, 120, 200, 333
Primary transducer	ES38-7	ES38-7
Transducer installation	Drop keel	Drop keel
Transducer depth (m) *	10	2
Upper integration limit (m)	15	15
Absorption coeff. (dB/km)	10.5	10.3
Pulse length (ms)	1.024	1.024
Band width (kHz)	2.425	3.06
Transmitter power (W)	2000	2000

Angle sensitivity (dB)	18	21.9
2-way beam angle (dB)	-20.3	-20.4
Sv Transducer gain (dB)		
Ts Transducer gain (dB)	27.03	26.94
s_A correction (dB)	-0.04	-0.13
3 dB beam width (dg)		
alongship:	6.43	6.47
athw. ship:	6.43	6.54
Maximum range (m)	500	500
Post processing software	LSSS	LSSS

* Note that range in acoustic data on Tarajoq is referenced from the surface, while on Árni it is from the face of the transducers, which is at ~10 m depth with the drop keel extended.

If possible two independent interpretations/scrutinizations of acoustic data should be made by two scientists before the final interpretation is determined. After that average NASC is found in quadrangles of dimensions 30' latitude and 1° longitude or 1° latitude and 2° longitude depending on how dense a coverage is possible. In case capelin is registered in more contained areas, other grid resolutions or approaches may need to be used. Trawl samples are used to assess size distribution and stock composition and the amount of capelin. Acoustic instruments are monitored 24/7 by the acoustics watch, in addition it is expected that each member of the acoustics watch participates in post processing, calculations and other duties. Acoustic interpretation should be done continuously during survey so that it is possible to deliver a stock estimate at the end of the survey. As soon as possible (a few days) after the survey finishes a survey report and a report on the stock estimate of capelin should be finished.

Submersible echosounder - WBT-TUBE

A calibrated submersible echosounder -WBT-Tube (Simrad EK80; ES38 18DK-split and ES120-7CD kHz) will be deployed during the capelin autumn survey on RV Árni to provide high-resolution acoustics data (35 to 45 and 90 to 170 kHz, respectively) of capelin schools down to a maximum 500m. The objective is to evaluate the influence of physiology and behaviour on the target strength of capelin. See further details on appendix WBT-TUBE regarding the instrument *mode of operandi.*

Echosounder calibration

If conditions permit all frequencies of the echosounder should be calibrated at the beginning and end of the survey, but at the earliest opportunity otherwise. The calibration procedure is mostly according to (Demer et al. 2015). See also appendix to acoustics manual/section of quality handbook. The plan is to use calibrations from April 2022 and later compare with calibrations in December 2022 to estimate stability of the echosounders.

Capelin gonad samples

Capelin gonads will be sampled onboard both vessels. The gonad sampling will be opportunistic (e.g. when researchers are uncertain of the correct maturity stage) where, at each station, up to 10 gonads from capelin >12cm length can be sampled into tubes filled with a 4% buffered formaldehyde solution, preserving the gonads for later histological embedding. The tubes will be labelled with; cruse ID, station no and fish no and sorted into a cardboard box. The samples from Tarajoq will be processed in Greenland/Denmark and the samples gathered onboard Arni will be processed in Iceland.

Zooplankton sampling

WP2-nets (at all CTD stations) and Bongo-nets (on the five main transects) (see **Appendix WP2** and **Appendix BONGO**) will be used to get information on zooplankton biomass and compositional data.

Trophic interactions in the pelagic ecosystem with emphasis on capelin

Capelin from the pelagic trawl will be used in the trophic study to sample stomachs (for detailed analysis see: **Appendix STOMACHS**).

CTD / hydrography

Hydrography will be conducted by taking CTD-stations on sections across the capelin distribution. The CTD-probe is lowered down to 500 m or to the bottom in shallower waters and a seawater sample will be collected at the deepest point. CTD-measurements (temperature, salinity etc.) give information on environmental parameters linked to capelin migration in addition to enabling estimation of sound speed and absorption through the water column for correct parametrization of the echosounders which is important for comparison of back-scatter on different frequencies.

Continuous recording of surface environmental parameters (underway)

Continuous recordings of at least temperature and salinity in the surface is on-going underway for the whole survey.

Fat composition

Frozen samples of 50 capelin > 14cm and 50 capelin < 14cm will be collected for estimation of fat proportion.

DNA samples

Frozen samples of 50 individuals at every second trawl station will be sampled for genetic analysis.

Whale observations

Systematic collection of data for estimating abundance of cetaceans and birds will not be conducted in 2021.

Opportunistic cetacean observations from bridge will be registered on observation sheets. Photographs for individual identification will be collected to the extent possible.

Appendices

Personnel, roles and shifts

Tarajoq

Name	Role	Shift
Lars Heilman	Chief Scientist/Fish lab/zooplankton	12 hours
Maria Pedersen	Acoustics, fish lab (first half)	8 hours + 4 other tasks
Maria Krueger-Larsen	Acoustics, fish lab (second half)	8 hours + 4 other tasks
Rune Garmund	Acoustics/Marine engineer	8 hours + 4 other tasks
Jørgen Sethsen	Fish lab/zooplankton	2 x 6 hours
Malthe Kjølhede Ahlmann Olesen	Fish lab/zooplankton	
Kristinn Guðnason	Acoustics (first half)	
Sigurvin Bjarnason	Acoustics (second half)	
Hildur Pétursdóttir	Zooplankton/fish lab (first half)	

Árni Friðriksson

Name	Role	Shift
Sigurður Þór Jónsson	Chief Scientist /Acoustic	
Warsha Singh	AcousticsAcoustics/Fisheries biology	
Thassya Christina dos Santos Schmidt	Acoustics/Plankton expert/Fish lab	
Ragnhildur Ólafsdóttir	Fish lab/zooplankton	
Sverrir Daníel Halldórsson	Fish lab/zooplankton	
??? …		

Telephone directory

Árni Friðriksson

412 1111 Bridge

412 1105 Machine room

412 1106 Crew

412 1107 Crew

Tarajoq

… to be provided by Greenland …

Capelin maturity staging

Gonad maturity stage	Name of maturity stage	Females 	Males 
1	Immature a	Juvenile fish. Gonads tubular, very thin (<1 mm), translucent, and without colour. Can be difficult to detect for inexperienced researcher. The sex is difficult to determine at this stage.	Juvenile fish. Gonads tubular, thin (<1 mm), translucent, and without colour. Can be difficult to detect for inexperienced researcher. The sex is difficult to determine at this stage.
2	Immature b	Ovaries thicker (more volume), transparent and without colour or with a hint of colour. Visible 'ripples' under the ovarian wall when the ovary is stretched. Relatively easy to determine sex.	Testes thicker (more volume), transparent and without colour or with a hint of colour. Testes are smooth when stretched, i.e. no 'ripples' visible. Relatively easy to determine sex.
3	Mature - ripening a	Ovaries bigger and occupy up to half the body cavity. Opaque with visible yellow-white specks (eggs). Blood vessels visible. Season in Iceland: October to December.	Testes opaque white or with white dots, firm and still of limited volume. Blood vessels visible. Season in Iceland: October to December.
4	Mature - ripening b	Ovaries bigger (more volume), colour yellow or white, and occupy up to 2/3 of the body cavity (related to somatic body conditions of the individual). Eggs (oocytes) distinct and grainy. Eggs, in the front end of the ovaries, becoming hydrated (turning transparent). Blood vessels visible. Season in Iceland: middle of December to January.	Testes bigger (more volume), colour light grey or white, and milt has high viscosity (thick liquid). Blood vessels visible. Season in Iceland: middle of December to January.
5	Mature - ripening c	Ovaries filling the body cavity. Majority of eggs hydrated (transparent). Ovaries do NOT run under pressure. Season in Iceland: latter part of January and February.	Testes grey or white. Milt has less viscosity (more runny liquid compared to stage 4). Milt does NOT run under pressure. Season in Iceland: latter part of January and February.
6	Spawning	Ovaries run when light pressure is applied to abdomen. Eggs are hydrated (transparent). Season in Iceland: February–March.	Testes run when light pressure is applied to abdomen. Season in Iceland: Febryary–March.
7	Spent	Ovaries slack with residual eggs. Season in Iceland: March.	Testes baggy, blodshot with residual milt. Season in Iceland: March.
8	Resting	Ovaries small, no eggs visible. Difficult to determine if stage is 8 or 2 or 3.	Testes small, no milt visible. Difficult to determine if stage is 8 or 2 or 3.

STOMACHS

Capelin and polar cod stomachs no. 1-10. The first 10 capelin and 10 polar cod stomachs from the fish sampled for otoliths will be collected and frozen immediately (one in each bag with a label and then put all the bags together in one larger one).

Bongo-net

Sampling with Bongo-net

A Bongo net is in fact two nets attached together. To estimate the seawater that is filtered by the net a flow meter is attached in both of the net openings, but depth is monitored with a Scanmar depth sensor attached to the wire just above the net. Mesh size is 500µm for both nets.

Sampling on the 5 main transects

1. Before the net is put out depth a reading is taken from the flow meter in the net opening. Flow meter is placed in one of two nets. We have the same mesh size, then we only need one flow meter.
2. The Bongo net is let out on the windward side. Captain or first mate determine when to start letting out and monitor .
3. **During sampling the net is let out down to 200 m depth while the vessel sails slowly (2.5 nmi h^{-1}), and then hauled back in resulting in a U-shaped profile through the water column. Both the descend and ascend rate should be close to 10 m $^{-min}$.**
4. When the net has been taken out of the water the net is rinsed thoroughly with seawater to flush all animals down into the collecting buckets. If the weather is mild it can be done with the net hanging outside the side of the ship. Be careful not to damage the animals and regulate the power of the seawater flow.
5. The net is lowered carefully on the deck. Take care the flow meter does not hit the deck, because it can damage the meter. It is recommended a deck hand or researcher holds the Bongo-net while it is being lowered to ensure a soft landing.
6. While on deck, a reading is taken from the flow-meters.
7. Finally, the two collecting buckets are removed, and they are taken into the lab where the samples are processed.

Preserving the samples in the lab

We have 2 samples.

- Sample from one net is weighed and preserved in 4% formaldehyde solution. Sample from the other net is frozen in plastic bag.

- All samples are marked with cruise, station number, date and gear (both on label and on the bag/vial).

WP2-net

Sampling with WP2-net

To estimate the seawater that is filtered by the net a flow meter is attached to the opening, but depth is monitored with a Scanmar depth sensor attached to the wire just above the net. Mesh size is 200 µm.

Sampling at all CTD stations

At every CTD station, 2 nets should be taken.

1. 0-50m, the sample is frozen (see below).
2. 0-200m, the sample is divided by Motoda splitter in to two. One half is preserved in formalin and the other one is frozen (see below). If the sample is less than 1ml put the whole sample in formalin (don´t split).

If the bottom depth is less than 200 m, the net should be lowered 10 meters from bottom.

Sampling

1. The depth is monitored with a Scanmar depth sensor monitored by the captain (50 and 200 m).
2. Before the net is put out a reading is taken from the flow meter in the net opening.
3. The net is lowered down to certain depth (50, 200 m).
4. The net is hauled back in at the speed of ~ 45 m per minute (takes approx. one minute for the 50 m and around 4 minuets for the 200 m).
5. When the net has been taken out of the water the net is rinsed thoroughly with seawater to flush all animals down into the collecting buckets. If the weather is mild it can be done with the net hanging outside the side of the ship. Be careful not to damage the animals and regulate the power of the seawater flow.
6. The net is lowered carefully on the deck. Take care the flow meter does not hit the deck, because it can damage the meter. It is recommended a deck hand or researcher holds the WP2-net while it is being lowered to ensure a soft landing.
7. While on deck, a reading is taken from the flow-meters.
8. The collecting bucket is removed, and the sample is put into 200 µ filter which is called Dr. hat (by us). Bring the hat with the sample to the lab.

Note: remember to record the numbers from the flow meter.

Preserving the samples in the lab

Formalin-samples

1. Measure the volume (ml).
2. Jellies are removed from the samples and measured (volume) separately and recorded. The jellies are then trown away.
3. Rest of the zooplankton sample is measured (volume) and recorded. Good to use a knife or a spoon to remove the sample from the filter (Dr. hat) to the volume-vial.
4. Displacement volume (rúmmál sýnis) (all together i.e. jelly and rest of the zooplankton) is recorded on the main sheet.
5. Pour the sample again to the filter.
6. Completed label is put **in** a glass vial. The sample is marked with cruise, year, station, date, gear, mesh size, and depth (50 or 200). Note: use pencil.
7. Preserved in 4% formaldehyde solution.
8. The sample should not take more than 1/3 of the volume of the glass vial and formalin 2/3. The glass vials hold 30 ml, if the sample is more than 10 ml it should be placed in a plastic vial.

Frozen samples

1. Measure the volume (ml).
2. Jellies are removed from the samples and measured (volume) separately and recorded. Then the jellies are thrown away.
3. Rest of the zooplankton sample is measured (volume) and recorded. Good to use a knife or a spoon to remove the sample from the filter (Dr. hat) to the volume-vial.
4. Displacement volume (rúmmál sýnis) (all together i.e. jelly and rest of the zooplankton) is recorded on the main sheet.
5. Pour the sample through a 1000µm filter with a Dr. hat and a white tray below to get the 2 different size groups (<1000µm and> 1000µm). Carefully drain the seawater into the filter - make sure that the white tray underneath does not fill up. Stop sliding into the filter when the white tray is ~ 2/3 full of sea and zooplankton. Gently dip the filter 3 times in the Dr. hat that lays in the white tray to filter better.
6. The part of the sample that went through the filter and ends up in the Dr. hat is the <1000µm sample.
7. The sample that is left on the filter is the > 1000µm sample. It differs in how researchers like to process it. Most researchers pick directly from the filter, but others want to put the sample on a tray (either white or black).
8. The <1000m sample is now rinsed with fresh water and then placed in a numbered aluminum tray.
9. The >1000µm sample is processed as follows: krill, amphipods, chaetognaths, shrimp and fish are picked out and placed in numbered aluminum trays (each group in a separate tray). The rest of the filter / tray is rinsed in a Dr hat, rinsed with fresh water and placed in a numbered aluminum tray (labelled > 1000). Be sure to always write the number of the freezer trays on the main sheet. The freezer trays are then placed in a zippered plastic bag and then in the freezer. Zipper bags should be marked with cruise, station number, tray number, depth and what is on the tray .

Átusýnataka og meðhöndlun sýna á íslensku

Ef botndýpi er minna en 200 m skal háfur nr. 2 fara 10 m frá botni.

Sýnataka

1. Til að mæla dýpið sem háfurinn fer niður á er notast við dýpisnema, sem festur er í segullásinn sem háfurinn er festur í. Stýrimaður í brú fylgist svo með dýpinu og kallar upp þegar tilskildu dýpi er náð (50 eða 200 m). Ef veður er gott og háfur fer nokkurn veginn lóðrétt niður í sjó má líka notast við merktan vír (vírinn er þá merktur á 50 og 200 m). Ágætt er að notast við bæði kerfin, hafa merktan vír og fylgjast með merkjunum. Það er svona auka trygging ef menn skyldu gleyma sér í brúnni. Best að hafa reglu á háfunum: byrja á 50 m háfum og taka svo 200 m háf.
2. Áður en háf er slakað í sjó þarf að lesa flæðismælistölu og skrá hana hjá sér. Gott er að hafa minnismiða með sér á dekk og skrá flæðismælistölur á háfablað þegar komið er aftur niður í labba.
3. Háfnum er slakað niður á tilskilið dýpi (50, 200 m).
4. Háfurinn er svo hífður upp aftur með hraðanum ~45 m á mínútu, þ.e. miða skal við að hífing frá 50 m dýpi taki u.þ.b. eina mínútu og frá 200 m dýpi u.þ.b. 4 mínútur.
5. Þegar háfur er kominn úr sjó þarf að skola háfinn vel með sjó (til að skola öll dýr niður í söfnunarbaukinn). Ef veður er gott er best að gera þetta með háfinn hangandi við skipshlið. Við þetta má nota spúl skipsins en gæta þess að krafturinn á spúlvatninu sé lítill, því annars skemmast dýrin.
6. Háfur hífður um borð og slakað varlega á dekk. Þegar háfnum er slakað á dekkið þarf að passa vel að flæðismælirinn skelli ekki í dekkið, því þá getur ásinn í honum skekkst og mælirinn eyðilagst. Gott er að hafa hönd á háfnum um leið og slakað er til að stuðla að mjúkri lendingu. Athugið að flæðismælar eru mjög dýrir!
7. Eftir tog er flæðismælistala skráð.
8. Söfnunarbaukur losaður frá og innihaldið sett í Dr-hatt.
9. Farið með Dr-hattinn inn á labba.

Ath. að skrá alltaf flæðismælistölur í upphafi og lok hvers togs á átueyðublað.

Meðhöndlun sýna í labba

Formalínsýni

1. Rúmmálsmæla sýnið (ml).
2. Mæliglas af hæfilegri stærð fyllt af sjó að merki (t.d. 20 ml).
3. Hveljur og hveljutætlur eru fyrst tíndar úr sýninu og settar í mæliglasið, rúmmálsaukning lesin af upp á ml. Rúmmál hveljanna skráð á háfablað. Þeim er svo hent að aflokinni mælingu.

4. Mæliglasið aftur fyllt af sjó að merki (t.d. 20 ml).
5. Átusýnið sett í glasið og rúmmálsaukningin lesin af upp á ml. Gott er að nota hníf eða skeið til að taka sýnið úr Dr-hattinum og setja í mæliglasið.
6. Niðurstaðan er rúmmál sýnisins („Displacement volume“) og er skráð á háfablað. ATH. að ef hvelja var í sýninu þá skal bæta þeim ml við rúmmál sýni.
7. Hella sýninu aftur í Dr-hattinn.
8. Setja merkimiða í glas sem á að varðveita sýnið. Merkimiði merktur með leiðangri, ári, stöð, dagsetningu, veiðarfæri, möskvastærð og dýpi (0-50 m eða 0-200 m). ATH. eingöngu nota blýant þegar skrifað er á merkimiðann.
9. Setja sýnið í glas með hlutleystu 4% formalíni. Gott að nota hníf eða skeið til að taka sýnið úr Dr-hattinum og setja í glas.
10. Á ógagnsæ plastglös skal auk þess setja glasamiða á tappa merktur leiðangri, ári, stöð, veiðarfæri, möskva og dýpi.
11. Þess skal gætt að sýnaglasið sé af hæfilegri særð. Miða skal við að sýnið fylli 1/3 glassins en formalín 2/3 hluta. Í glerglösin rúmast 30 ml, ef sýni er meira en 10 ml þá skal það fara í plastglas.

Frystisýni

1. Rúmmálsmæla sýnið (ml).
2. Mæliglas af hæfilegri stærð fyllt af sjó að merki (t.d. 20 ml).
3. Hveljur og hveljutætlur eru fyrst tíndar úr sýninu og settar í mæliglasið, rúmmálsaukning lesin af upp á ml. Rúmmál hveljanna skráð á háfablað. Þeim er svo hent að aflokinni mælingu.
4. Mæliglas aftur fyllt af sjó að merki (t.d. 20 ml).
5. Átusýnið sett í glasið og rúmmálsaukningin lesin af upp á ml. Gott er að nota hníf eða skeið til að taka sýnið úr Dr-hattinum og setja í mæliglasið.
6. Niðurstaðan er rúmmál sýnisins („Displacement volume“) og er skráð á háfablað. ATH. ef hvelja var í sýninu þá skal bæta þeim ml við rúmmál sýnis.
7. Sýnið stærðarflokkað (<1000µm og >1000µm) með því að sía í gegnum 1000µm síu.
8. 1000µm sía sett í Dr-hatt og þá næst í hvítan bakka með dálitlu af sjó í.
9. Sýnið sett á síuna. Gott er að nota hníf eða skeið til að skafa sýnið úr Dr-hattinum og setja í síuna.
10. Sjór látinn renna varlega ofan í síuna - passa að hvíti bakkinn undir fyllist ekki.
11. Hættið að láta renna ofan í síuna þegar hvíti bakkinn er ~2/3 fullur af sjó og dýrum.
12. Síunni dýft varlega 3-svar sinnum ofan í hvíta bakkann til að sía betur.
13. Það sem fór í gengum síuna og hafnar í Dr-hattinum er <1000µm -sýnið.
14. Það sem er á síunni er >1000µm sýnið og er mismunandi hvernig fólki finnst best að vinna það. Flestir tína beint úr síunni en aðrir vilja setja sýnið á bakka (ýmist hvítan eða svartan) og pikka úr honum.
15. <1000µm sýnið er nú skolað með fersku vatni og síðan sett í númeraðan álbakka.
16. >1000µm sýnið er meðhöndlað þannig:
17. Ljósáta, marflær, pílormar, rækjur og fiskseiði tíndar úr og settar í númeraða álbakka. Ath. hver hópur er á sér bakka ekki allir saman.
18. Það sem eftir er á síunni/bakkanum er skolað ofan í Dr-hatt, skolað með fersku vatni og sett í númeraðan álbakka.
19. Athugið vel að skrá alltaf númer frystibakkanna á háfablað.

20. Frystibakkarnir eru svo settir í rennilásaplastpoka og síðan í frysti. Merkja skal rennilásapokana með leiðangri, stöðvanúmeri, númeri bakka, dýpi og eftir atvikum stærðarflokki eða hvað í honum er (ljósáta, marflær o.s.frv.)

WBT-Tube: Capelin project

Research questions:

1. Are narrowband (CW) mean TS-length assumptions used currently in stock assessment correct?

2. Is there a significant variability in capelin backscatter that should be accounted for instead of using overall geometric mean?

    a. Depth/pressure dependency
    b. Seasonal dependency
    c. Body condition dependency

3. Can broadband (FM) measurements increase the quality of acoustic estimates?

    a. FM backscattering properties of capelin
    b. Are measurements in FM frequency channels comparable to CW measurements?

4. Can the high-density FM single target detections give full count of targets in the sampling volume?

Autumn survey: 5 – 21 September 2022 onboard r/v Árni F.

The aim of using WBT-Tube (Simrad EK80; ES38 18DK-split and ES120-7CD kHz) within the capelin project is to provide high-resolution acoustic data (35 to 45 and 90 to 170 kHz, respectively, for broadband) of capelin schools down to at most 500 m. The objective is to evaluate the influence of physiology and behaviour on the in-situ target strength of capelin. The main goals are to assess in-situ target strength measurements of capelin with respect to depth dependence, gonad status, fat content and behaviour (swimming angle of the fish).

Sampling should be in narrowband and broadband (FM mode) on both 38 and 120 kHz. We will focus on specific capelin schools observed at 38kHz. The PI on shift will then decide which capelin schools to collect samples from. The equipment will be lowered to ~20m from dense schools, and acoustic registrations will be recorded for at least 15 minutes.

Aim to collect:

1. WBT-TUBE acoustic data on narrowband (CW mode) and broadband (FM mode) on both 38 and 120 kHz, at least 10 to 15 minutes on each mode.

2. Collect additional information from hull-mounted acoustics on broadband on both 38 and 70 (120 kHz if the capelin schools are close to the surface, or at less than 100 m depth).

    a. At trawl stations where the schools are close to the surface (< 50 m).
    b. Before the WBT-TUBE deployment.

3. Cameras (with infrared filters) would be tested during the first deployments to evaluate if they may be used further. If there is a lot of avoidance when the lights are turned on, we will not use them. Electromagnetic interference from the cameras could also make us decide not to use them.

4. Trawl samples are necessary and should be collected before deploying the WBT-tube. Length measurements (mm) and standard procedures regarding maturation and age reading. Additionally, fat measures are needed to get better information on the condition of the fish.

Ideally, we should deploy the WBT-TUBE after each trawl. We should aim for a minimum of 4 intermediate and deep deployments (Table 1 approximates the deployment times for possible depths). In this project, acoustic sampling should focus on a minimum of 3 WBT-TUBE deployments for each depth range based on the capelin schools' position, more specifically shallow (0-100 m), middle (100-200 m) and deep (>200 m) schools. In table 2, there is a description of the deployments already made in this project, so in this **autumn survey 2022, we should focus on the middle and deep deployments where the fish schools are mainly composed of mature fish.**

Table 1. Deployment times are dependent on the depth of the schools.

Depth (m) of schools	Hour	Number deployments	Total hours
100	**0.5**	**3**	**1.5**
250	**1**	**5**	**5**
500	**1.5**	**5**	**7.5**
			=14

Table 2. Stations deployments in the past cruises.

Season	Cruise	Depth range [m]	Nr. WBT-TUBE stations	Nr. hull-mounted acoustics stations
Autumn	A14-2021	<100		2
	B10-2021	<100	1	2
		100-200	1	
Winter	A01-2022	<100	1	3
		>200	1	
		100-200	1	
	A02-2022	<100		1
		>200	2	

Precautions when using the WBT-Tube and optical cable:

- Take care that the optical cable is not bent and avoid stepping on the cable and make sure that heavy weights do not fall on top of the cable.
- One needs to take special care that the optical cable runs smoothly during the descent and ascent of the WBT-Tube.
- Turn on EK80 only when the WBT-Tube is submerged ~10 m in the water column.
- A Scanmar cannot be attached to the WBT-Tube frame to record depth; therefore, one must take notes on the marks on the cable (or use the cable meter counter).
- The initial descent of the WBT-Tube should be at a reduced speed (**<0.2 m s^{-1}, i.e. 12 m min^{-1}) until it reaches 10 m depth**. The descent and ascent rates should **be less than 1m s^{-1} (i.e. 60 m min^{-1}) at depths below 10 m**.
- 900 m (see the mark in the optical cable) is the maximum length that the optical cable can go underwater.
- Ensure that the WBT-Tube does not touch the seafloor and is at a safe distance (>10 m depth).
- A technician will operate the optical cable electronic winch for the first deployments.

During deployment

The WBT-Tube will be deployed after trawl hauls.

1. Make sure that all connections in the WBT-Tube are closed.

2. Make the descent of the WBT-TUBE at a lower speed **ca. 0.2 m s^{-1} (i.e. 12 m min^{-1} up to 10 m depth)** from the surface until the tube is completely submerged and see if the tripod sinks fast enough, so there is no entanglement of wires.
3. Wait after instructions from the researcher in charge of the WBT-Tube until the EK80 is turned on (maximum pinging and select sequential pinging). The WBT-Tube is lowered down at **~0.8 m s^{-1} (i.e. 48 m min^{-1}) to 20 m distance above the dense acoustic school observed.**
4. The WBT-Tube is lowered down, and acoustic data will be recorded for at least ~15 minutes at every 20 m distance above the target acoustic layer/school(s) (i.e. 20 m from each dense layer/school of interest), while the vessel is drifting.
5. The WBT-Tube is then **hauled slowly at ~0.8 m s^{-1} (i.e. 48 m min^{-1}) to 10 meters** depth from the surface and stopped there until the researcher stops recording and EK80 is turned off.
6. Ensure that a researcher holds the frame while it is being handled onboard to ensure the equipment has a soft landing on the deck and the optical cable is not bent in the process.
8. After deployment, rinse the equipment with tap water, but first, make sure that all connections are closed.

Outcomes:

- Raw acoustic data (hull-mounted and WBT-Tube) and Starmon measurements (tilt, temperature, and depth) will be saved on shared folders on the research vessel network for onboard postprocessing and backed up for post-cruise processing.
- The single targets (dB) and total backscatter will be stored as nautical area scattering coefficient values (s_A, m^2 nmi^{-2}) with –70 dB and -82 dB lower threshold in the second resolution).
- TS vs length relationship
- Ts vs depth
- Ts vs condition of the fish
- Comparison of broadband and narrowband acoustics
- Comparison of ship and TUBE narrowband acoustics

Log sheets for WBT-Tube deployment (file name: WBT-tubelog.xls)

Whale registrations

Eyðublað fyrir skráningu á hvölum um borð í leiðöngrum Hafrannsóknastofnunar 2019

Dagsetning	Tími	Staðsetning	Hvalategund	Fjöldi hvala á svæði (hópstærð)	Atferli og aðrar athugasemdir

Skýringar

Reglulegar hvalatalningar Hafrannsóknastofnunar hafa einkum farið fram að sumarlagi þegar fjöldi flestra tegunda er talinn í hámarki. Auk slíkra skipulegra talninga er mikilvægt að skrá hvalagengd á öðrum árstímum. Allar slíkar viðbótarupplýsingar eru gagnlegar þótt ekki ekki sé það gert af sömu nákvæmni og í skipulegum talningum. Umtalsverðar breytingar hafa orðið á hvalagengd við landið á undanförnum árum og mikilvægt að skrásetja allt sem að gagni gæti komið við að meta þær breytingar. Að sjálfsögðu er best að skrá sem nákvæmastar upplýsingar en oft eru hlutirnir óljósir og þá betra að skrá bil eða besta/skársta mat frekar en að sleppa skráningu (t.d. hópstærð 10-30, tími um kl 14-15).

Skýringar á dálkum

Dagsetning. Skrá á forminu: dd.mm.ár t.d. 01.01.2019

Tími: T.d. 14:45 eða bil kl. 16-18

Staðsetning: Helst í lengd og breidd, annars með lýsingu: á rauða torginu, eða ca 100 mílur NA af Langanesi

Hvalategund: Eins nákvæmt og hægt er (t.d. langreyður) Ef óvissa má t.d. segja hnúfubakur?, langreyður eða steypireyður, höfrungategund, stórhveli, smáhveli o.s.frv.

Fjöldi hvala (hópstærð): Fjöldi hvala sem sjást á svæðinu (eða hópstærð t.d. ef um er að ræða háhyrninga- eða höfrunahópa). Oft er erfitt að meta fjöldann og þá gott að skrá bil t.d. 3-5, 10-20, 100-200

Atferli og athugasemdir. Hér má skrá hvaðeina sem gæti komið að gagni. Eru hvalirnir að éta, er fuglager í kring um þá, voru teknar myndir, voru kálfar í hópnum o.s.frv.

Station sheet

Station information will be documented on special paper sheets for each operation on board. Further a new software collecting station information, trawl trajectories and other information will be used as an experiment for more digitized and automated documentation of such parameters in the future.
Example of trawl station sheet:

HAFRANNSÓKNASTOFNUNIN

Sýnisnúmer:

(útfyllist v/innsl.)

Leið. eink. | *Ár* | *Stöð*	*Sk. Skr.nr.*	Vindátt	Lofthiti°	Síriti	
Dags. / mán.		Vindhraði	Botnhiti°	Sonda	
Reitur | *Smár.*	*Tog. nr.*	Sjór	Yfirborðshiti°	DST	
| *Skiki*	*Fjarðarroitur*	Veður	Hiti á togdýpi°		
Veiðarfæri nr. | *Möskvastærð*	*Grnd. lengd fm.*	Ský	Sjóndýpi (m)		
Kennitala veiðaf.	*Heildarafli*	Loftvog	Ís		
Kastað	*N. br.*	*V. le.*	Hift	*N. br.*	*V. le.*
	Kl.	*Togstefna°*		*Kl.*	*Vir úti (fm)*
	Botndýpi (m)	*Togdýpi (m)*		*Botndýpi (m)*	*Togdýpi (m)*
	Lóðrétt opnun (m)	*Hlerabil (m.)*		*Toglengd (sjm)*	*Togtími (mín)* | *Toghraði (sjm)*

ATH.