Preliminary Cruise Report
Cruise no. 1652

Faroese part of International Ecosystem Summer Survey in the Norwegian Sea 2016

4 – 21 July 2016

M/T Tróndur í Gøtu

Jan Arge Jacobsen
Ebba Mortensen
Poul Vestergaard
Páll Mohr Joensen

HAVSTOVAN
FAROE MARINE RESEARCH INSTITUTE
POBox 3051 - FO 110 Tórshavn, Faroe Islands

INTRODUCTION

The main aim of this survey was to investigate the distribution and abundance of Northeast Atlantic mackerel (mackerel), Norwegian spring-spawning herring (herring) and blue whiting in the Northeast Atlantic. Zooplankton and hydrographic data were collected along the cruise tracks.

The cruise was part of the joint International Ecosystem Summer Survey in the Nordic Seas (IESSNS). Three parties and four research vessels (see text table below) took part in the survey, coordinated by the "Working Group of International Pelagic Surveys" (WGIPS) in ICES (formerly WGNAPES). The results from all vessels combined will be used in the assessment of mackerel, herring and blue whiting by the "Working Group on Widely Distributed Stocks" (WGWIDE) in August 2016.

Vessel	**Nation**
Tróndur í Gøtu	Faroes
Vendla	Norway
M. Ytterstad	Norway
Árni Fríðriksson	Iceland

The present survey report is based on data from M/V *Tróndur í Gøtu* only. Therefore no biomass estimate is given due to incomplete coverage of the area, only the results from the Faroese survey.

MATERIAL AND METHODS

Cruise tracks with hydrographic stations (CTD), WP2 plankton stations and pelagic trawl stations are shown in **Figure 1**. For mackerel the surface swept-area trawl survey method was used based on 30 min trawling at regularly spaced (approximately 1 degree) trawl stations on equally spaced latitudinal tracks with a randomly selected starting latitude. The specifically designed standard MULTPELT 832 survey trawl (**Table 1**) with standardised rigging was used conforming to standard operational settings (see Nøttestad et al. 2016 for further details). For herring and blue whiting standard acoustic survey methods were used. The acoustic data were recorded with a Simrad EK-60 echo sounder. Data from the hull mounted 38 kHz transducer were logged at sea and used in the fish abundance estimation. The area backscattering recordings (s_A) per nautical mile were averaged by each nautical mile and the recordings were scrutinised on a daily basis with the EchoView 7 software and allocated to herring, blue whiting, plankton and other fish based on pelagic trawling aimed at the various acoustic recordings. The trawl gear was monitored during trawling with designed trawl sensors measuring depth, spread of the trawl. Light measurements were done during trawling. The 38 kHz Echo sounder was calibrated prior to survey with a standard copper sphere.

RESULTS

The total survey effort (number of trawlstations and biological sampling) is shown in **Table 2 and 3**. The various trawl settings and operation details are given in **Table 4** and the acoustic settings in **Table 5**. The depth of the trawl doors, the door spread and vertical opening of the trawl are given in **Table 6**, and the reported values were all within the standards recommended for the MULTPELT trawl.

Mackerel

Mackerel was caught on all the 39 predetermined surface trawl stations in the survey area (**Figures 1 and 2**). The average catches of mackerel were higher in the survey area in 2016 as compared to 2015. It should however be noted that the covered areas were not identical, but the difference was rather large, about one third higher in 2016. The catches of mackerel and herring on each surface

trawl station are shown as pie charts in **Figure 2**. It can be seen that the highest concentrations of mackerel were observed north of the Faroes, on the Iceland-Faroe ridge and in the northeastern part of the surveyed area (**Figure 2**).

The mean length of mackerel was 34 cm and mean weight 345 g, but there were two tops in the length distribution, one at 29 cm and one at 34 cm (**Figure 3**). The top at 24 cm could indicate that a recruiting year-class is about to enter the stock, and by looking at the age distribution (**Figure 4**) it can be seen that a high number of two year old mackerel was observed, especially in the eastern part of the surveyed area. The larger mackerel were mainly 4-6 year old fish (**Figure 4**).

Norwegian spring spawning herring

The average catches of herring also indicated higher abundances in 2016 as compared to the last two years. The surveyed area changes somewhat between years and this can affect the observed biomass. However, the acoustic registrations were lower than should be expected from the amount caught in the surface trawl hauls. This could be attributed to a significant portion of the herring being located above the depth of the hull mounted acoustic transducer.

Herring was observed in a broad band from southeast of the Faroes in a northwestern direction towards Iceland (**Figure 2 and 5**). However the herring observed east of the Faroes is thought to be mainly local Faroese autumn-spawning herring (**Figure 2**). The herring north of the Faroes and towards Iceland is Norwegian spring-spawning herring, while the herring close to eastern Iceland might be of the Icelandic summer-spawning origin (**Figure 2 and 5**).

During night the herring was observed as a layer at 10-50 m depth in the southern part of the survey area that formed to small schools at 250-300 m depth during day. In the northern area the schools were observed deeper as well during day. The highest abundances were observed in the eastern part of the surveyed area (**Figures 5 and 6**).

The length distribution of herring showed two tops, one at 30 cm and one at 35 cm (**Figure 7**). By looking at the length distributions from each haul it was discovered that the smaller (30 cm) herring was caught east of the Faroes, i.e. the Faroese herring, while the larger Norwegian spring-spawning herring with an average length above 35 cm was caught in the northern and western areas.

The age distribution shows one peak at 12 year old herring, corresponding to the last rich year-class (2004 year-class) of Norwegian spring-spawning herring (**Figure 8**). Also younger 5-8 year old herring was caught.

Blue whiting

Blue whiting was found in a rather loose scattering layer from 100 m down to about 350-400 m more or less throughout the whole survey area (**Figure 9**). The density of the blue whiting layer was higher in the continental slope areas and on the Iceland-Faroe Ridge as seen from the s_A values per each nautical mile (**Figure 9**). The corresponding average s_A values per statistical square (1/2 by 1 degree) are shown in **Figure 10**.

The length distribution of blue whiting is shown in **Figure 11**. The mean length was 23.7 cm and the meanweight 84 g, thus rather small fish. The bulk of the blue whiting was 2 to 4 year old fish with high numbers of 1 year old as well (**Figure 12**).

Other species
Lumpfish of all sizes were caught in small numbers in the upper 30 m of the water column on most stations within the surveyed area. Four Atlantic salmon were also caught in the northern area.

Zooplankton
Zooplankton was sampled on all trawl stations with WP2 200 my zooplankton net. In total 39 stations. The main zooplankton throughout the survey area was *Calanus finmarchicus*, which is the main food source for mackerel and herring during summer. Some small hyperiid amphipods (*Themisto* sp.) were also among the zooplankton species caught.

Hydrography
The sea-surface temperature (SST) in the surveyed area was between 8.8 and 13°C (**Figure 13**). Temperature and salinity casts down to 500 m if possible were taken along the track (39 stations).

References

Nøttestad, L., Utne, K. R., Oskarsson, G. J., Jónsson, S., Jacobsen, J. A., Tangen, Ø., Anthonypillai, V., Aanes, S., Vølstad, J. H., Bernasconi, M., Debes, H. H., Smith, L., Sveinbjørnsson, S., Holst, J. C., Jansen, T., and Slotte, A. 2016. Quantifying changes in abundance, biomass, and spatial distribution of Northeast Atlantic mackerel (*Scomber scombrus*) in the Nordic seas from 2007 to 2014. *ICES Journal of Marine Science 73*, 359-373.

Table 1. Trawl specifications for the Faroese MULTPELT 832 in July 2016.

Circumference (m)	832
Vertical opening (m)	34.8
Mesh size in codend (mm)	40
Typical towing speed (kn)	5.0 (4.7–5.2)

Table 2. Survey effort for Tróndur í Gøtu 4-21 July 2016.

Effective survey period	Length of cruise track (nm)	Trawl stations	CTD stations	Plankton sampling	Aged fish mackerel/herring/ blue whiting	Length-measured fish
4-20/7	3000	39	39	38	662/638/250	3633/2117/1213

Table 3. Summary of biological sampling in the Faroese survey from 4-21July 2016. Numbers denote the maximum number of individuals sampled for each species for the different determinations.

	Species	Faroes
Length measurements	Mackerel	200/100*
	Herring	200/100*
	Blue whiting	200/100*
	Other fish sp.	0
Weighed, sexed and maturity determination	Mackerel	25
	Herring	25
	Blue whiting	25
	Other fish sp.	0
Otoliths/scales collected	Mackerel	25
	Herring	25
	Blue whiting	25
	Other fish sp.	0
Stomach sampling	Mackerel	10
	Herring	10
	Blue whiting	10
	Other fish sp.	0
Tissue for genotyping	Mackerel/Herring	0/30

*200 length measurements of which 100 are also weighed

Table 4. Trawl settings and operation details during the IESSNS 2016 July 2016.

Properties	**Tróndur í Gøtu**
Trawl producer	Vónin
Warp in front of doors	Dynema – 34mm
Warp length during towing	350 m
Difference in warp length port/starboard	20-25 m
Weight at the lower wing ends	400 kg
Setback in metres	6 m
Type of trawl door	Injector F-15
Weight of trawl door (kg)	2300
Area trawl door (m^2)	6
Towing speed (knots)	5.0 (4.7-5.2)
Trawl height (m)	34.8
Door distance (m)	108.7
Trawl width (m)	-
Turn radius	5-10 degrees BB turn
A fish lock in front end of cod-end	Yes
Trawl door depth (port, starboard, m)	7.8, 7.4
Headline depth	0 m
Float arrangements on the headline	Kite + 2 buoys on wingtips
Weighing of catch	All weighted

Table 5. Acoustic instruments and settings for the primary frequency in the IESSNS 2016 July survey in 2016.

Parameter	M/V Tróndur í Gøtu
Echo sounder	Simrad EK 60
Frequency (kHz)	38,120, 200
Primary transducer	ES38B
Transducer installation	Hull
Transducer depth (m)	6
Upper integration limit (m)	7
Absorption coeff. (dB/km)	9.8
Pulse length (ms)	1.024
Band width (kHz)	2.43
Transmitter power (W)	2000
Angle sensitivity (dB)	21.9
2-way beam angle (dB)	-20.6
TS Transducer gain (dB)	24.29
s_A correction (dB)	-0.65
alongship:	7.12
athw. ship:	7.19
Maximum range (m)	500
Post processing software	Sonardata Echoview 7.x

Table 6. Descriptive statistics for trawl door spread, vertical trawl opening and tow speed for the Faroese IESSNS 2016 survey in July 2016. Two different kinds of data were analyzed, manually reported towing speed values from (one value per station from the GPS) and digitally recorded data from trawl sensors. Digitally recorded data were filtered prior to calculations; for trawl door spread all values < 90 m and > 130 m were deleted and for vertical opening all values < 10 m and > 50 were deleted. The average values per station were used to calculate overall mean, maximum (max), minimum (min) and standard deviation (st.dev.). Number of trawl stations used in calculations is also reported.

	Tróndur í Gøtu
Trawl doors horizontal	
Number of stations	39
mean	108.7
max	114.7
min	104.8
st. dev.	4.5
Vertical trawl opening (m)	
Number of stations	37
mean	34.8
max	38.1
min	31.8
st. dev.	2.9
Speed (over ground, nmi)	
Number of stations	39
mean	5.0
max	5.2
min	4.7
st. dev.	0.12

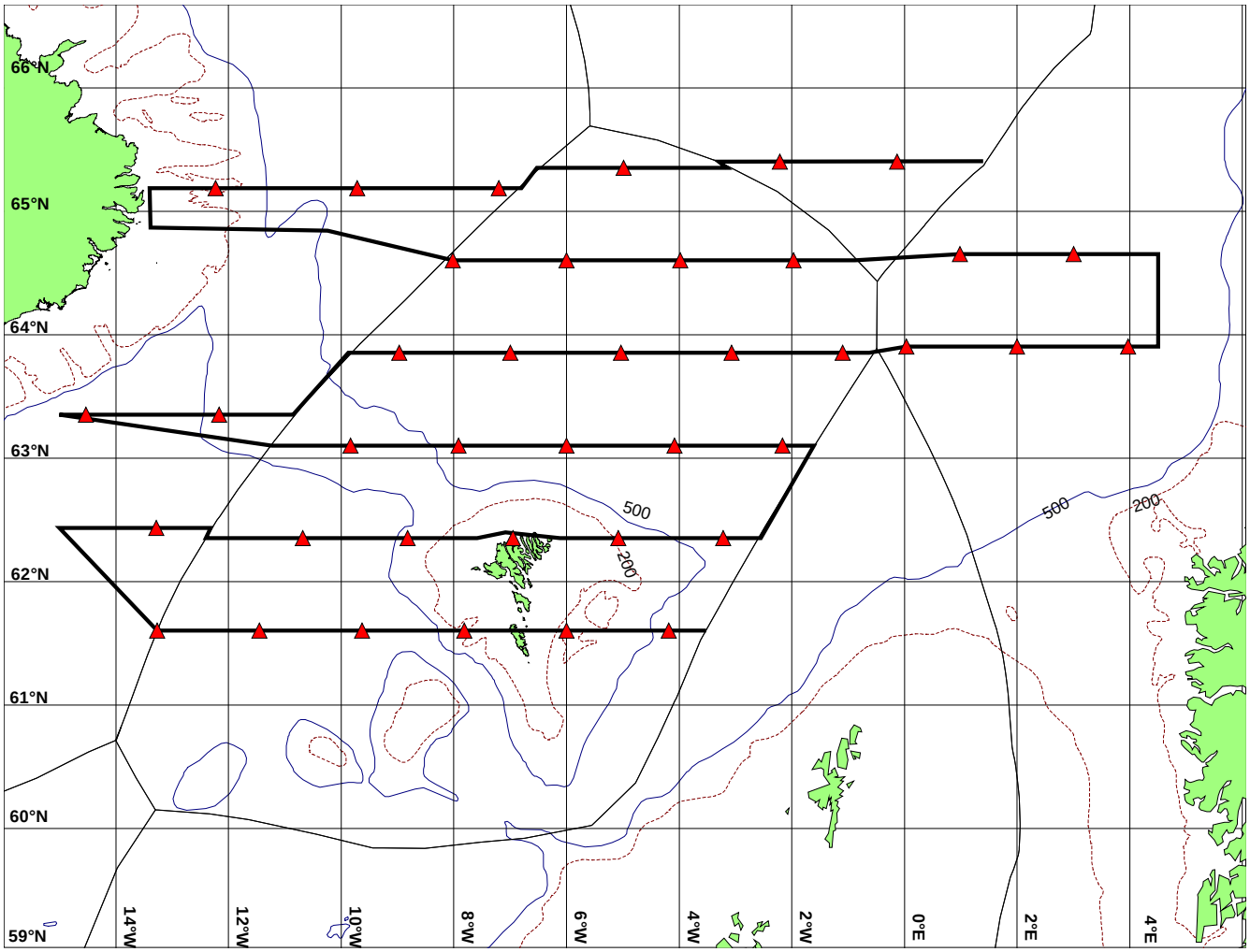

Figure 1. Cruise tracks with trawl/CTD/WP2 stations (red triangles) during the IESNS 2016 cruise with *Tróndur í Gøtu* cruise 1652, 4-21 July 2016. The total covered distance was 3000 nautical miles.

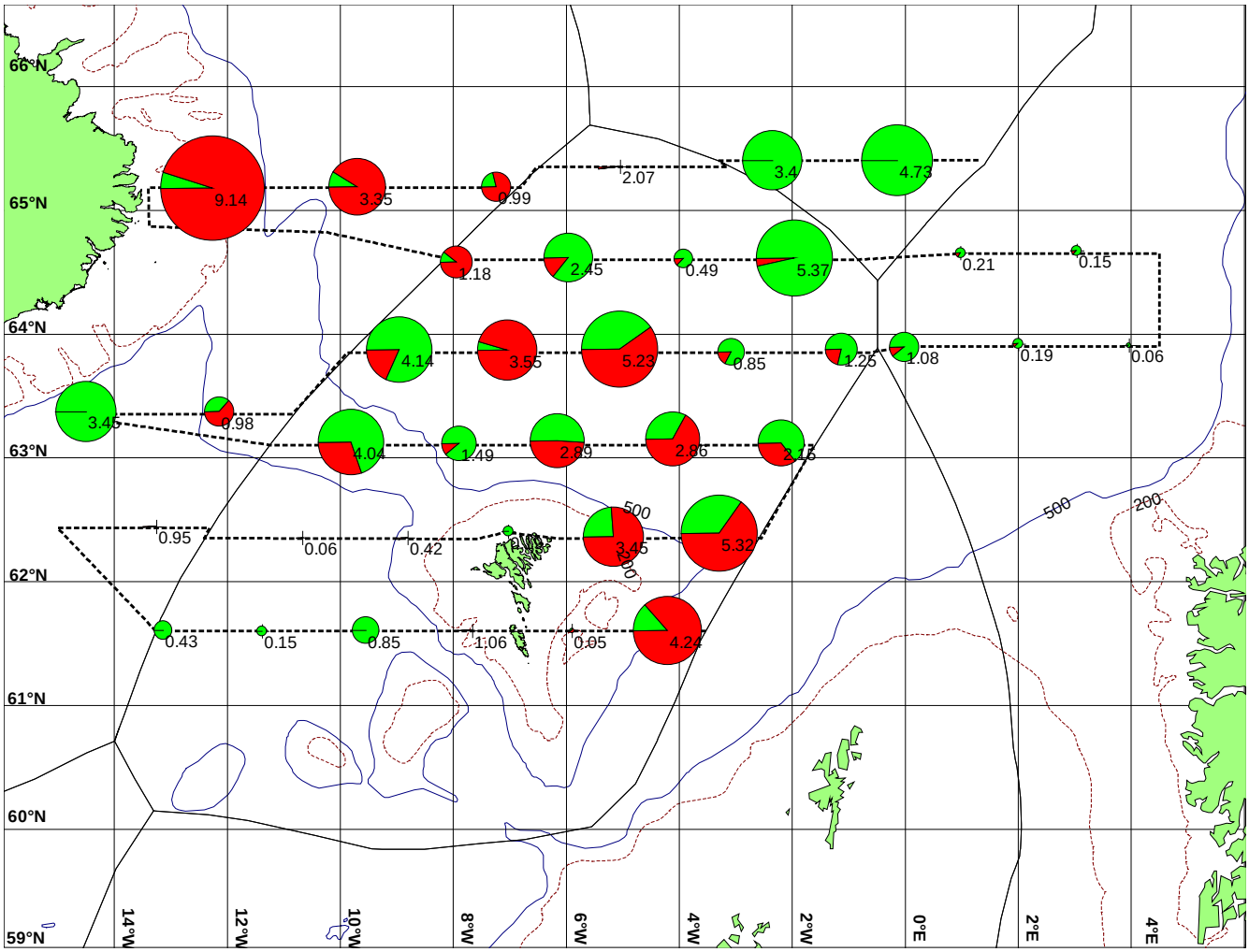

Figure 2. Catch of mackerel (green) and herring (red) by ½ hour trawl haul on predetermined trawl stations approximately 60 nm apart. The size of the circles corresponds to total amount of fish caught (in tonnes). IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

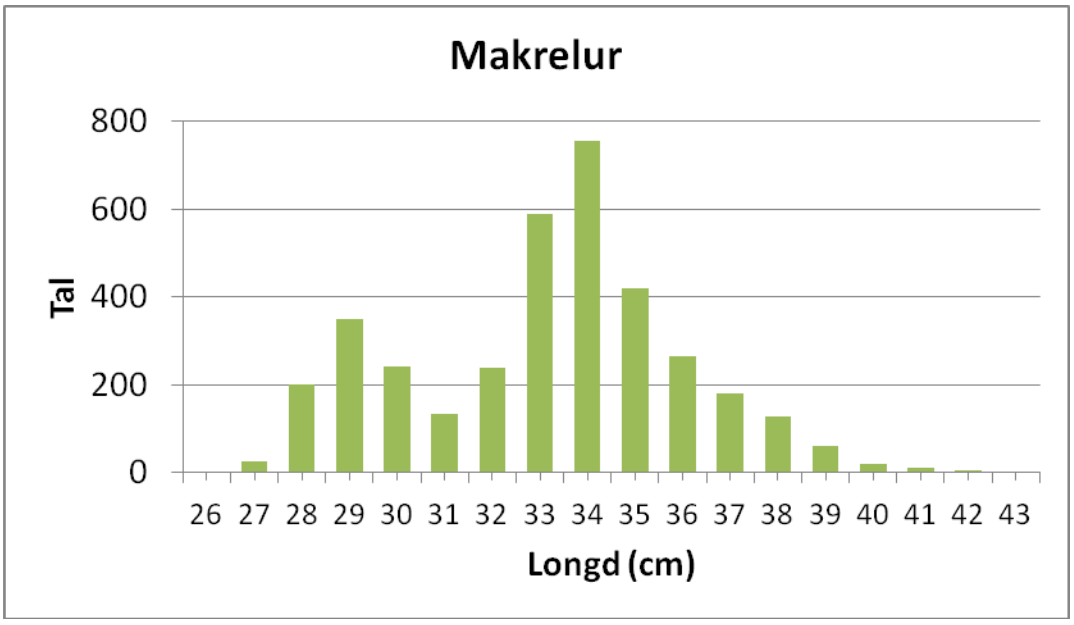

Figure 3. Length distribution of mackerel during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

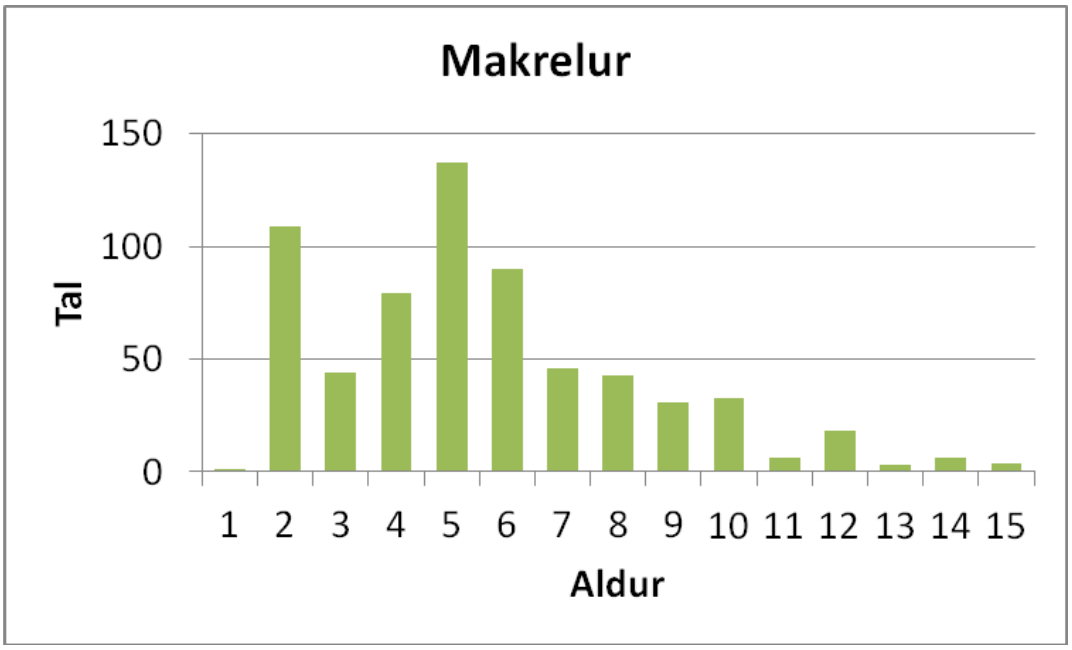

Figure 4. Age distribution of mackerel during the IESSNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

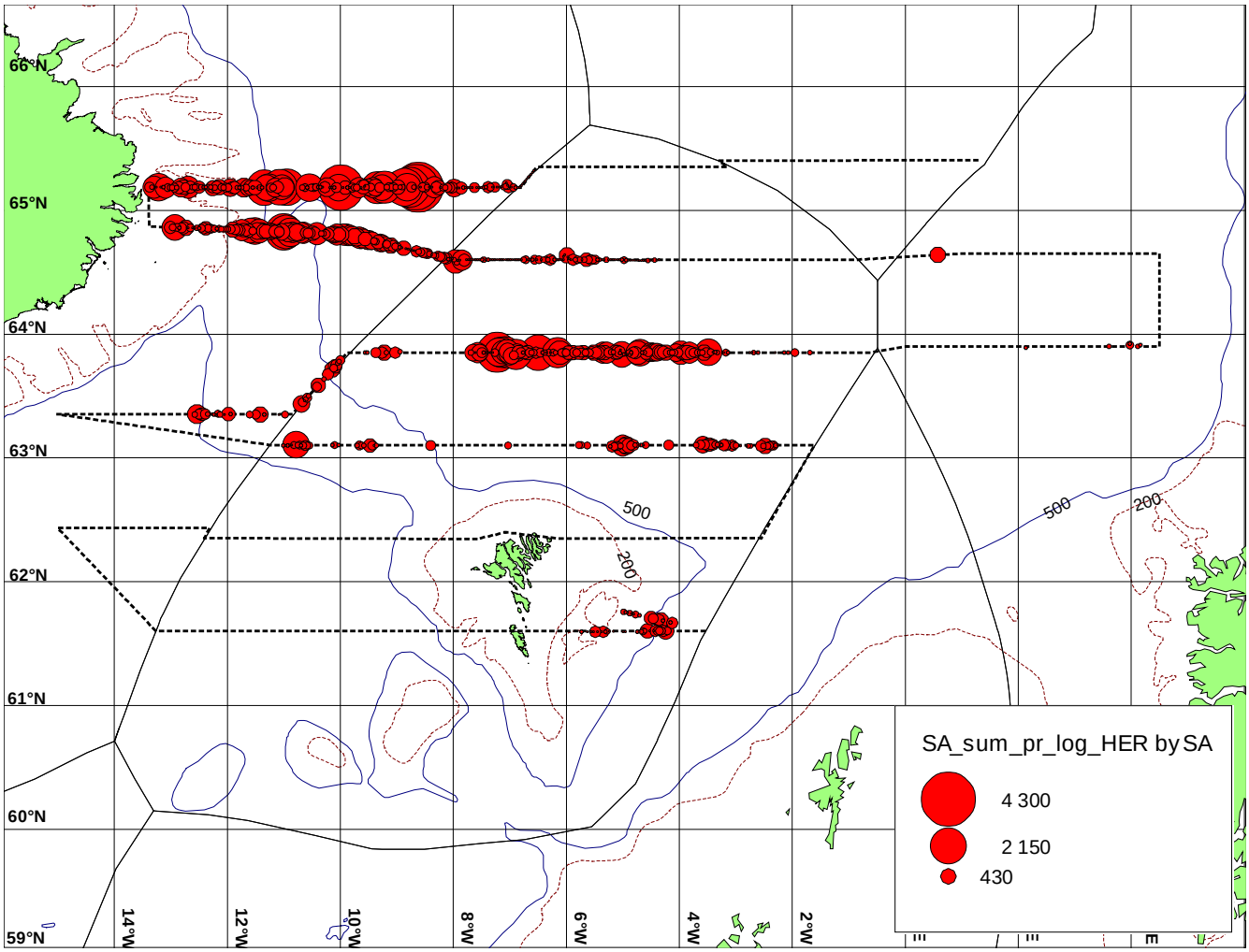

Figure 5. Mean integration values (s_A m^2/nm^2) per nautical miles of Norwegian spring spawning herring along the cruise track. The size of the circles corresponds to amount of fish detected. IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

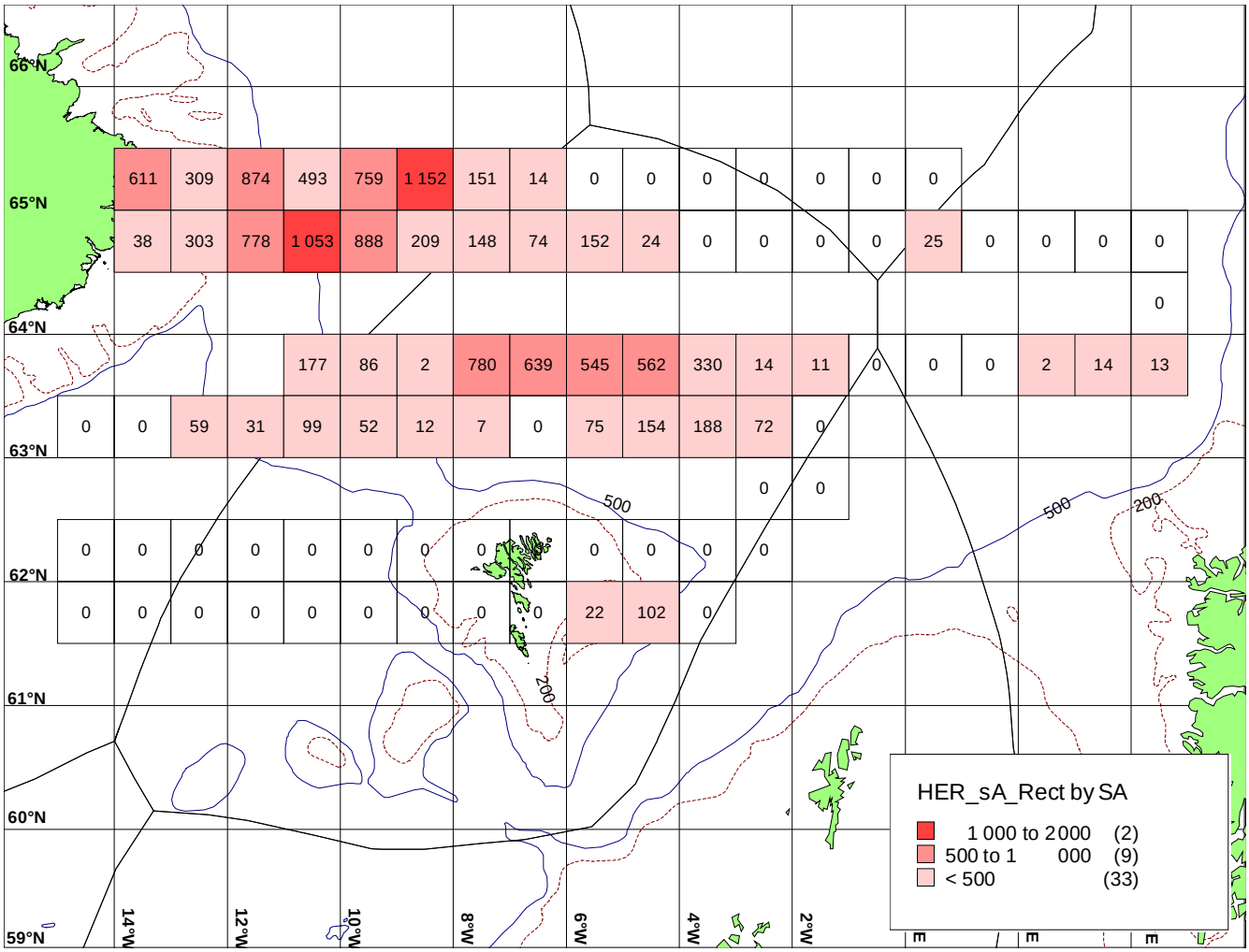

Figure 6. Mean integration values (s_A m^2/nm^2) of Norwegian spring spawning herring per statistical square (1x2 degrees). IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

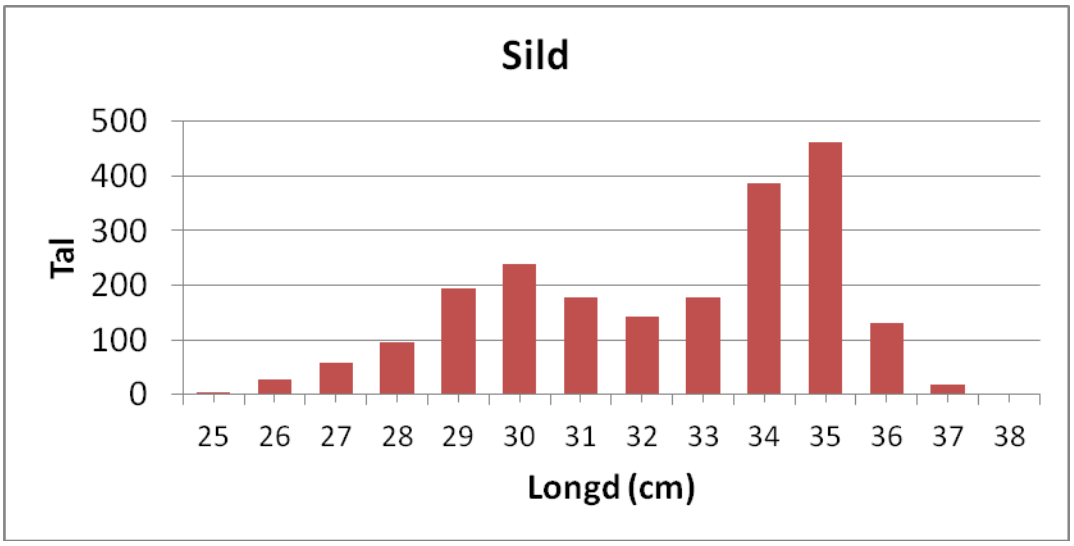

Figure 7. Length distribution of Norwegian spring spawning herring during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

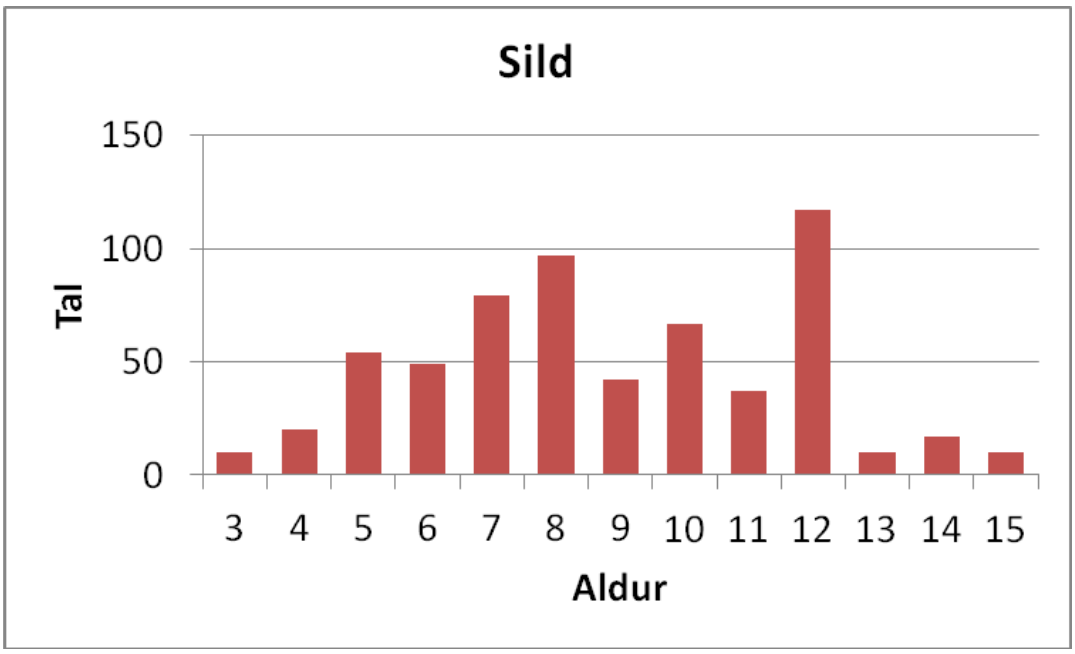

Figure 8. Age distribution of Norwegian spring spawning herring during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

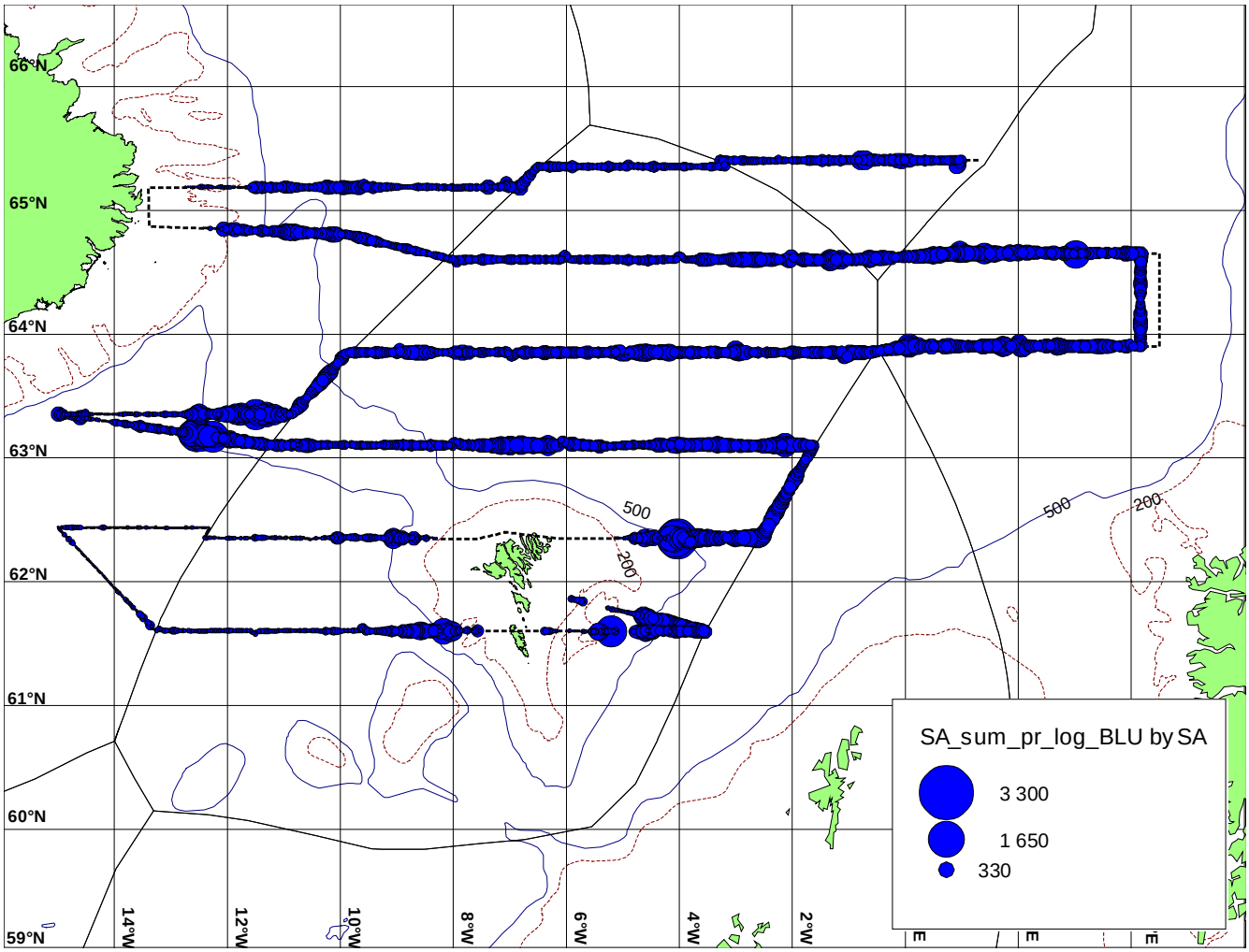

Figure 9. Integration values (s_A, m^2/nm^2) of blue whiting per each nm along the cruise tracks. The size of the circles corresponds to amount of fish. IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

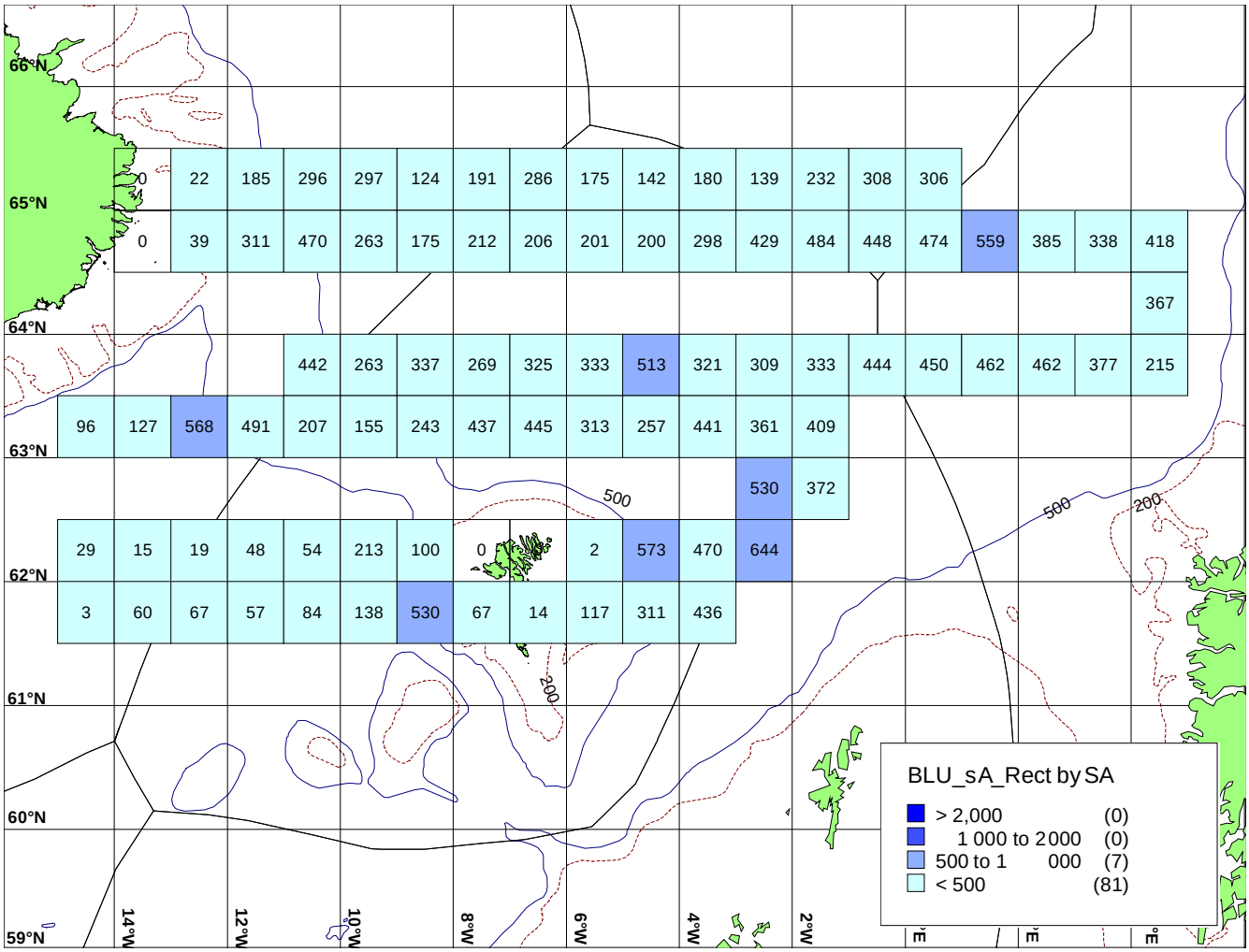

Figure 10. Mean integration values (s_A m^2/nm^2) of blue whiting per statistical square (1x2 degrees). IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

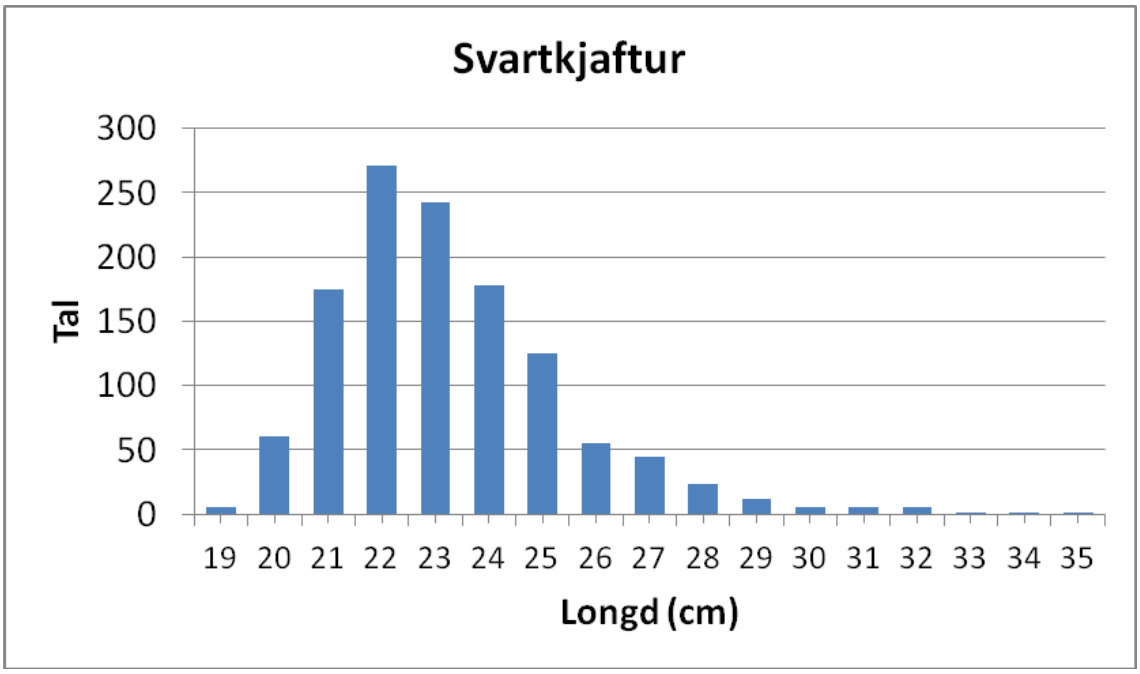

Figure 11. Length distribution of blue whiting during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

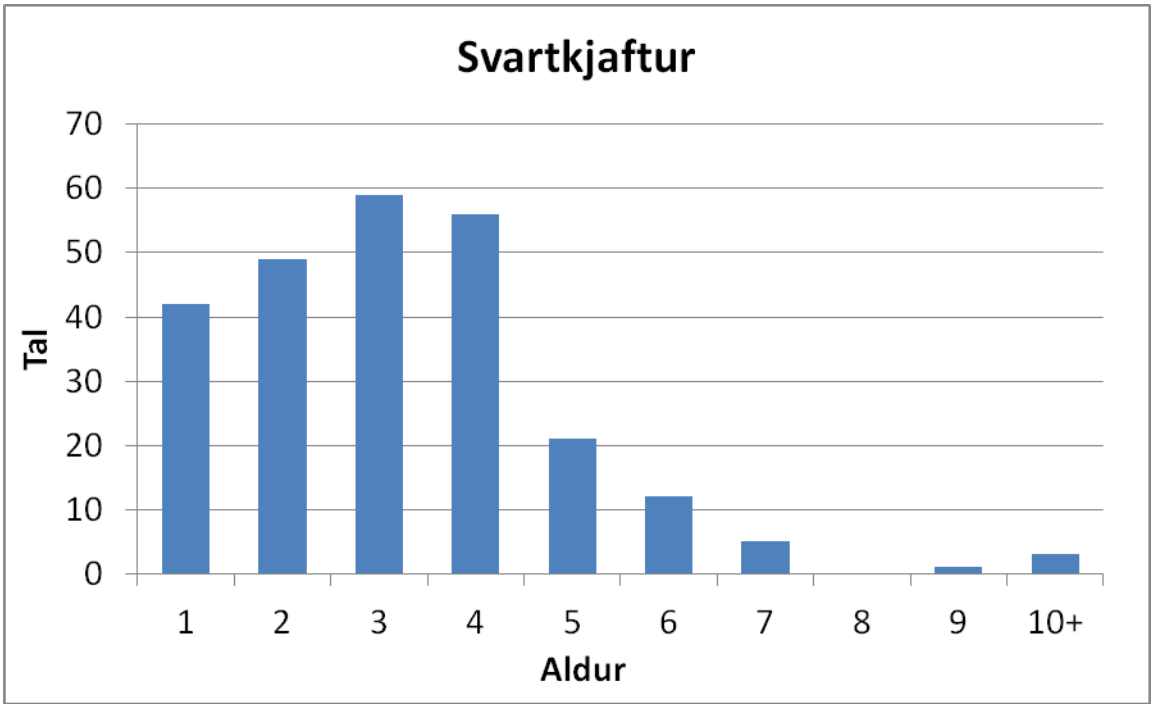

Figure 12. Age distribution of blue whiting during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.

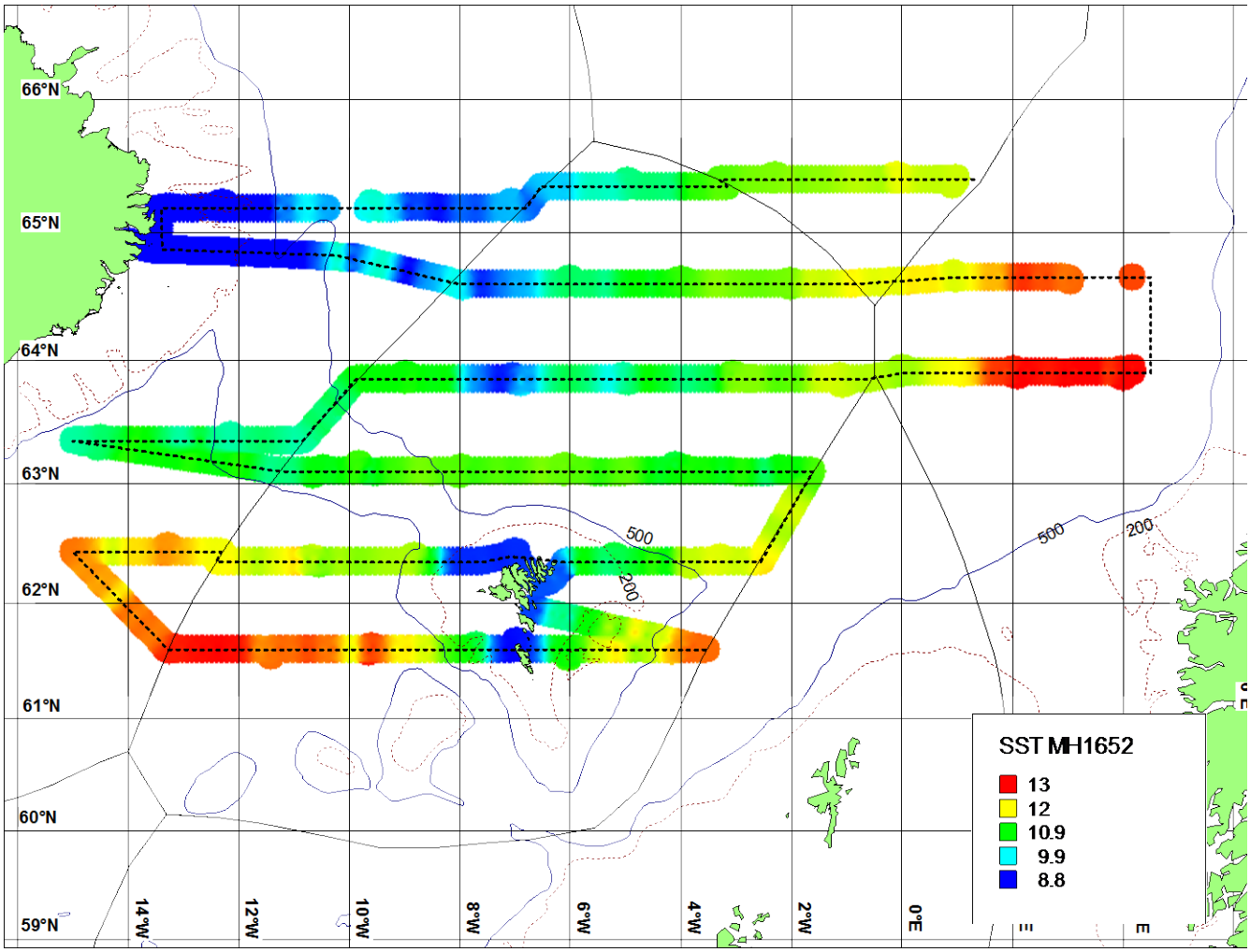

Figure 13. The sea-surface temperature along the cruise track during the IESNS 2016 cruise, *Tróndur í Gøtu* cruise 1652, 4-21 July 2016.