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# Cruise report
# FRV "Walther Herwig III" Cruise 385
# 18.06. – 20.07.2015

## German Participation in the International Deep Pelagic Ecosystem Survey in the Irminger Sea and Adjacent Waters

Scientist in charge: Dr. Eckhard Bethke

## Summary

This cruise is part of a co-ordinated effort of ICES (International Council for the Exploration of the Sea) to undertake an International Deep Pelagic Ecosystem Survey in the Irminger Sea and adjacent waters in June/July 2015, estimating the abundance and biomass of the pelagic beaked redfish (*Sebastes mentella*) stocks and conducting additional observations relevant to integrated ecosystem assessment in the area.

The main objective of the survey and the international co-operation of the survey were planned by the "ICES Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS – former name ICES Working Group on Redfish Surveys)" which met in Tromsø, Norway, 3-5 February 2015 (ICES. 2015. Second Interim Report of the Working Group on International Deep Pelagic Ecosystem Surveys (WGIDEEPS). ICES CM 2015/SSGIEOM:02).

The survey takes place every two years and was scheduled to be a joint survey by Germany with the FRV "Walther Herwig III", by Iceland (FRV "Árni Friðriksson") and by Russia (RV "Vilnyus"). However, Russia canceled the participation shortly before the cruise started. The "Walther Herwig III" cruise part started on 18 June and ended on 20 July 2015. Within this period, the distribution and density of redfish was recorded, and the length composition, individual weights, sex and maturity, stomach contents and the infestation with parasites were analyzed. In addition, the hydrographic conditions in the investigation area were recorded.

Preliminary estimates of the stock sizes will be available in the middle of August 2015. The international Survey Working Group (WGIDEEPS) will meet in Reykjavik, Iceland, from 4-6 August 2015.

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## 2. Research program

### 2.1. Survey design

The objective of the cruise was to record a hydroacoustic profile of the area where it was possible to measure beaked redfish (*Sebastes mentella*), undisturbed by echoes from other smaller fishes and plankton (acoustic layer). This is generally possible above the deep scattering layer (DSL). Within and deeper than the DSL (around 350-950 m), redfish abundance was investigated by standardized trawl hauls. Trawl hauls were carried out also within the acoustic layer to get information about the length structure of the stock and to compare the catch rates with the acoustic values. Therefore, it was possible to obtain absolute fish density values from the trawl results. Three types of trawl hauls were distinguished:

- Depth shallower than the DSL, trawl duration 65 min (approx. 4 nautical miles)
- Depth within the DSL, but shallower than 500 m, trawl duration 65 min (approx. 4 nautical miles (two horizons))
- and below 500 m, trawl duration 114 min (approx. 7 nautical miles (three horizons))

The hauls were evenly distributed along the transects (hydroacoustic measurements) across the area in a compromise between available working time and distances to sail. Individual fish data, such as fish length, weight, sex, maturity, stomach fullness, parasitic infestation and pigments on the skin and in the muscle tissue, were recorded. For the determination of age structure, fish otoliths (ear stones) were taken. For genetic analyses of the stock structure, tissue samples of the gill filaments were taken from 263 redfish.

### 2.2. Acoustic registration

The recordings were made with a 38 kHz Simrad EK60. A hull-mounted transducer was used, the vessel speed was 10 knots, and a depth range from 0-350 m was covered. The echo integration, the allocation of the area backscattering strength ($s_A$) to redfish was carried out with the EchoView software (Myriax), recalculating the target strength distribution to integration values. The specific settings of the hydroacoustic equipment are given in Table 1. Generally, the measurements were conducted with medium pulse length and wide bandwidth. During hydroacoustic integration, the water depth was measured with the 18 kHz channel of the fishery sounder.

### 2.3. Oceanography

CTD (Conductivity, Temperature, Depth) stations were performed after each trawl station with the Seabird 9 Plus 6800M CTD-probe. Additionally, CTD stations were carried out at the corners of the transects. The mean distance between the stations was about 60 NM. All CTD stations reached a depth of 1000 m.

## 3. Narrative

FRV “Walther Herwig III” left Bremerhaven at 3:00 p.m. on Wednesday, 18 June, heading for the calibration position in Scotland (Loch Eriboll). However, an engine error was detected and the vessel had to return to the island of Helgoland for repair. On Sunday, 21 June, we continued our journey to our calibration destiny. The calibration position (Loch Eriboll, Scotland) was reached on 23 June and the calibration was finished successfully. On Friday, 26 June, we reached the operating area. Since Russia had canceled its participation prior to the cruise, the covered area was changed in agreement with the Icelandic participant. Due to bad weather conditions a further cut of the cruise track was necessary. Nevertheless, the program could be completed almost as planned. The field work was finished in the night of 12 July. FRV “Walther Herwig III” was back in the port of Bremerhaven on Sunday 19 July early in the morning at 4:00 a.m.

## 4. Preliminary results

### 4.1. Calibration

The hull-mounted 38 kHz EK500 was calibrated in Loch Eriboll, Scotland, on 23 June 2015. The conditions were good, so reliable results were obtained. For the calibration the EK-60 calibration module was used (results of the calibration are given in the Table 1).

### 4.2. Acoustic Estimation

Due to experiences from the last surveys, it was known that redfish in this area are widely distributed, allowing a counting of the fish. Based on the counting results, the $s_A$ values were computed and allocated to redfish $s_A$ values. A $S_v$ threshold of – 80 dB/$m^3$ was used for echo integration. However, a constant TS threshold of -47 dB was used for echo counting. This corresponds to a time-varied $S_v$ threshold and yields more reliable results if the recording of echoes is disturbed by echoes of other small fish and plankton. Within and deeper than the DSL, hydroacoustic measurements were not possible. In this depth range, the fish density was measured by trawl hauls. Acoustic measurements were also not possible during the night. During this time, one part of the DSL migrated upwards almost approaching the surface but was also distributed over the whole water column. As a consequence, the night time was used preferably for fishing. The measured $s_A$ values of FRV “Walther Herwig III” are presented in Fig. 1.

### 4.3 Fish sampling

***Beaked Redfish (Sebastes mentella)***

During the survey, 39 trawl hauls were carried out with the GLORIA 1024 pelagic net, fitted with a multiple codend sampling device: the ‘multisampler’, allowing successive sampling at three distinct depth zones within one trawl haul and without ‘contamination’ from one depth to the next and no sampling during shooting or heaving of the trawl. The geographical distribution of the hauls is shown in Fig. 2. The maximum amount of beaked redfish caught by FRV “Walther Herwig III” in that area was 7.8 kg/NM (mean 1.7 kg/NM). The total catch of the survey was 608 individual redfish with a total weight of 341.4 kg. The largest concentrations were found between a longitude of 37° and 40°W and latitude of 55° and 58° N. The mean total length of the redfish was 35.1 ± 3.2 cm and mean weight was 561 ± 161 g. The mean total length of redfish caught below 500 m (deep pelagic stock; T3 in Figure 3), was 37.4 ± 3.6 cm with a mean weight of 673 ± 190 g, whereas the mean total length of redfish caught above 500 m (shallow pelagic stock; T1 and T2 in Figure 3) was 35.1 ± 2.2 cm for T1 and 34.0 ± 3.1 cm for T2 and mean weights of 551 ± 112 g for T1 and 517 ± 148 g for T2.

Individual fish data of 608 redfish, such as fish total length, weight, sex, maturity, stomach fullness, parasitic infestation and pigments on the skin and in the muscle tissue, were recorded. For the determination of age structure, the otoliths (ear stones) of 588 fishes were taken. For genetic analyses, tissue samples from gill filaments of 263 (43% of all redfish caught) redfish were taken and stored in ethanol.

***Mesopelagic fishes (Stephanie Czudaj)***

The aim of the cruise participation was to gain an impression of the mesopelagic species community in a subpolar region as opposed to the main focus region of the research group in the tropical/subtropical North Atlantic in the Project PREFACE; for a broader understanding of the mesopelagic ecosystem functioning and to increase taxonomic expertise.

Mesopelagic fishes in net trawls were identified to species level and individuals sampled genetically as part of collaborative work with the research group of Thomas Knebelsberger at the Senckenberg Institute. Individual reference samples of each species were preserved in formaldehyde for the ichthyological collection at the Thünen-Institute of Sea Fisheries in Hamburg. Of abundant species of mesopelagic fish, having a focus on the melamphaid *Scopelogadus beani*, as well as occasionally crustaceans, samples of 20 individuals were frozen for potential use in comparative studies, depending on body condition and availability with respect to other cruise participants’ scientific needs.

In brief, species composition was rather similar across the survey area. Dominant in biomass and abundance were the myctophids *Lampanyctus macdonaldi* and *Benthosema glaciale*, accompanied at more southern stations by *Myctophum punctatum*, as well as the deep sea smelt *Bathylagus euryops*. Fewer in numbers, but constant in occurrence were: the diverse group of tubeshoulders (Platytroctidae), the melamphaid *Scopelogadus beani*, the sawtooth eel *Serrivomer beani*, the barracudina *Arctozenus risso* and among the stomiiformes the viperfish *Chauliodus sloani*, the snaggletooth *Borostomias antarcticum* and the scaly dragonfish *Stomias boa ferox*.
Rarer catches encompassed the predatory swallower *Chiasmodon niger* as well as the fangtooth *Anoplogaster cornuta*, different species of anglerfishes, an occasional slickhead, and the redmouth whalefish *Rondeletia loricata*.

***Fish systematics (Matthias Mertzen, Deutsches Meeresmuseum, Stralsund, Germany)***

In the Volkswagen(VW)-project: „Hering, Lachs und Karpfen – alte Bekannte mit unbekannter Verwandtschaft – Phylogenie der basalen Clupeocephala“ (Herring, Salmon and Carp, old acquaintances with unknown relations – Phylogeny of the basal Clupeocephala”), the systematic structure of the basal Clupeocephala such as Clupeoformes, Salmoniformes and Cypriniformes, but also exotic species like Aulopiformes and Alepocephaloidei are being analyzed. Numerous hypotheses are known about the phylogenetic development of this large group, but with many strong contradictions. For morphological and molecular analyses, fish from the different orders are needed. Therefore, it was a great opportunity to join the International Deep Pelagic Ecosystem Survey in the Irminger Sea and adjacent waters. On this survey more than 7 different species out of 3 families of the Alepocephaloidei were caught. In addition, many deep sea species from families like Stomidea, Myctophidae, Melamphaidea were sampled for the collection of the Deutsches Meeresmuseum in Stralsund, Germany.

***Parasitological examinations (Vera Zizka, Institute of Integrative Parasitology and Animal Physiology, Goethe University Frankfurt)***

Samples of 13 different fish species (10-150 individuals) were collected and deep frozen for further processing at the Goethe University Frankfurt. Sampling was focused on beaked redfish (*Sebastes mentella*) and species of the families Stomiidae (4 species) Myctophidae (4 species) and individual representatives of the Serrivomeridae, Bathylagidae, Alepocephalidae and Paralepididae. Samples will be part of parasitological examinations and stomach content analyses to get insights in the feeding ecology of the targeted fish species and to describe their parasite diversity, abundance and infection intensity. Findings will help in understanding parasite life-cycle ecology and parasite-host relationships in the region of the Irminger Sea and adjacent waters. Furthermore, comparisons of parasite pattern and feeding ecology of concerned fish will lead to conclusions and hypotheses on food web constructions and predator-prey interactions as well as life cycle processes and parasite distribution. Parasitological findings of *S. mentella* will be included in long term studies to detect variations in parasite pattern and to assess the state of health of this species.

***Cephalopods (Volker Miske, Universität Greifswald)***

During the scientific fishery on redfish, cephalopods were caught as bycatch. Cephalopods caught in the closing nets were sampled quantitatively in relation to the depth layer and location parameters. Since a part of the specimens got entangled in the net tunnel in front of the multisampler device, about 30 metres of this part of the net was additionally qualitatively examined for cephalopods. More than 1300 specimens of squids and pelagic octopods from at least 7 species belonging to 6 families were obtained. Many of the specimens were damaged, partly up to a degree so that morphological identification down to species level was not possible. Standard measurements and tissue samples for genetic analyses were taken. By far the most

common cephalopods caught were armhook squids (*Gonatus* sp.). Most of the specimens of this group had mantle lengths (body standard measure) between about 35 and about 65 millimeters, weighing on average about 7.5 grams. From *Gonatus* specimens with undamaged mantle tips, mantle length – weight relations were obtained. Cephalopods, especially armhook squids, play an important role in the ecosystem investigated. Selected specimens of cephalopods and fish were documented photographically and preserved.

### 4.4. Oceanography

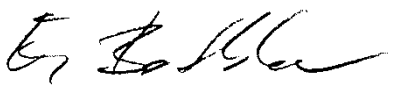
CTD (Conductivity, Temperature, Depth) stations were performed with the Seabird 9 Plus 6800M CTD-probe. The stations were evenly distributed and the mean distance between the stations was about 60 NM. Additionally, CTD stations were carried out at the corners of the transects. All CTD stations reached a depth of 1000 m. Water temperatures in 200-1000 m depth varied between 3.32 and 6.65 °C. Salinity and temperature data will be evaluated by the fisheries hydrography group of the Institute of Sea Fisheries, Hamburg, Germany.
Robert Sanderson – Dalhousie University: At selected stations, water samples were taken to analyze the amount of inorganic carbon (DIC and TA) and nutrients to study fresh water sources and their connection to Labrador Sea, as well as inorganic carbon and nutrient dynamics and their interactions. The samples were transported to Canada and Iceland and will be analyzed at Dalhousie University (Canada) and the Marine Research Institute (Iceland).

## 5. Participants

| | Name | Function | Institution |
|---|---|---|---|
| 1. | Dr. Eckhard Bethke | Cruise leader | TI-SF |
| 2. | Dr. Matthias Bernreuther | Leader fish biology | TI-SF |
| 3. | Farzaneh Kazemi | Student helper | TI-SF |
| 4. | Svenja Zakrzewski | Student helper | TI-SF |
| 5. | Inken Hanke | Student helper | TI-SF |
| 6. | Stephanie Czudaj | PhD student | TI-SF |
| 7. | Vera Zizka | Guest scientist | Goethe- University, Frankfurt |
| 8. | Matthias Mertzen | Guest scientist | Dt. Meeresmuseum, Stralsund |
| 9. | Volker Miske | Guest scientist | University Greifswald |
| 10. | Robert Sanderson | Guest scientist | Dalhousie University |

## 6. Acknowledgement

Thanks to Captain Stefan Meier and FRV “Walther Herwig III” crew members for their great support and hospitality and to all participants for their reliable and responsible teamwork.



Dr. Eckhard Bethke
Cruise leader

**Table 1 Calibration results**

```
#  Calibration  Version   2.1.0.12
#
#  Date:  23.06.2015
#
#  Comments:
#
#
#  Reference Target:
#    TS                  -33.60 dB       Min. Distance         17.00 m
#    TS Deviation          7.0 dB        Max. Distance         22.00 m
#
#  Transducer:  ES38B  Serial No.   30445
#    Frequency           38000 Hz        Beamtype                Split
#    Gain                26.50 dB        Two Way Beam Angle   -20.6 dB
#    Athw. Angle Sens.     21.90         Along. Angle Sens.     21.90
#    Athw. Beam Angle    7.10 deg        Along. Beam Angle    7.10 deg
#    Athw. Offset Angle  0.00 deg        Along. Offset Angle  0.00 deg
#    SaCorrection         0.00 dB        Depth                 6.20  m
#
#  Transceiver:  GPT  38 kHz 009072069780 2-1 ES38B
#    Pulse Duration      1.024 ms        Sample Interval     0.191   m
#    Power                2000  W        Receiver Bandwidth   2.43 kHz
#
#  Sounder Type:
#    EK60 Version  2.4.3
#
#  TS Detection:
#    Min. Value          -50.0 dB        Min. Spacing           100 %
#    Max. Beam Comp.       6.0 dB        Min. Echolength         80 %
#    Max. Phase Dev.          8.0        Max. Echolength        180 %
#
#  Environment:
#    Absorption Coeff.   9.4 dB/km       Sound Velocity     1494.2 m/s
#
#  Beam Model results:
#    Transducer Gain    = 23.22 dB       SaCorrection       = -0.63 dB
#    Athw. Beam Angle   = 7.33 deg       Along. Beam Angle  = 7.24 deg
#    Athw. Offset Angle = 0.12 deg       Along. Offset Angle=-0.04 deg
#
#  Data deviation from beam model:
#    RMS =    0.12 dB
#    Max =    0.30 dB  No. =   200  Athw. = -3.2 deg  Along = -2.8 deg
#    Min =   -0.41 dB  No. =   279  Athw. = -1.1 deg  Along = -4.6 deg
#
#  Data deviation from polynomial model:
#    RMS =    0.08 dB
#    Max =    0.37 dB  No. =   271  Athw. =  0.6 deg  Along = -4.9 deg
#    Min =   -0.37 dB  No. =   279  Athw. = -1.1 deg  Along = -4.6 deg
```

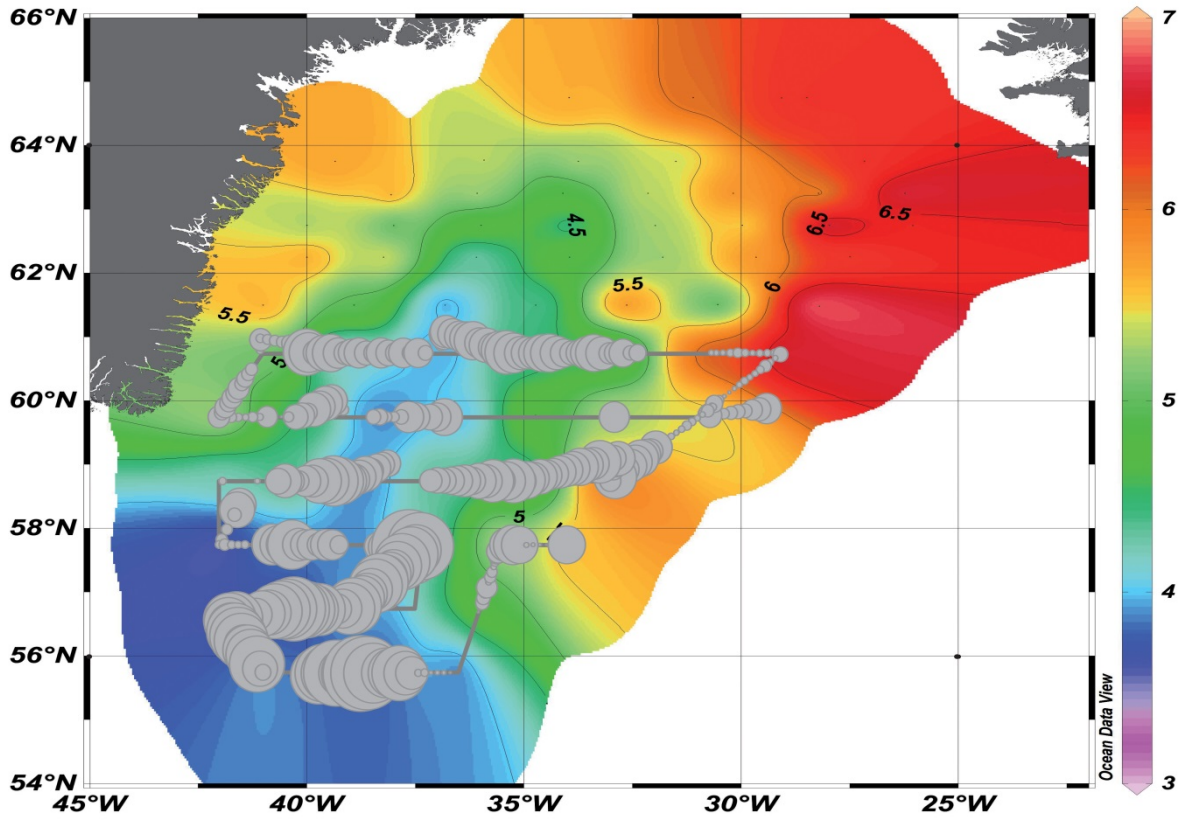
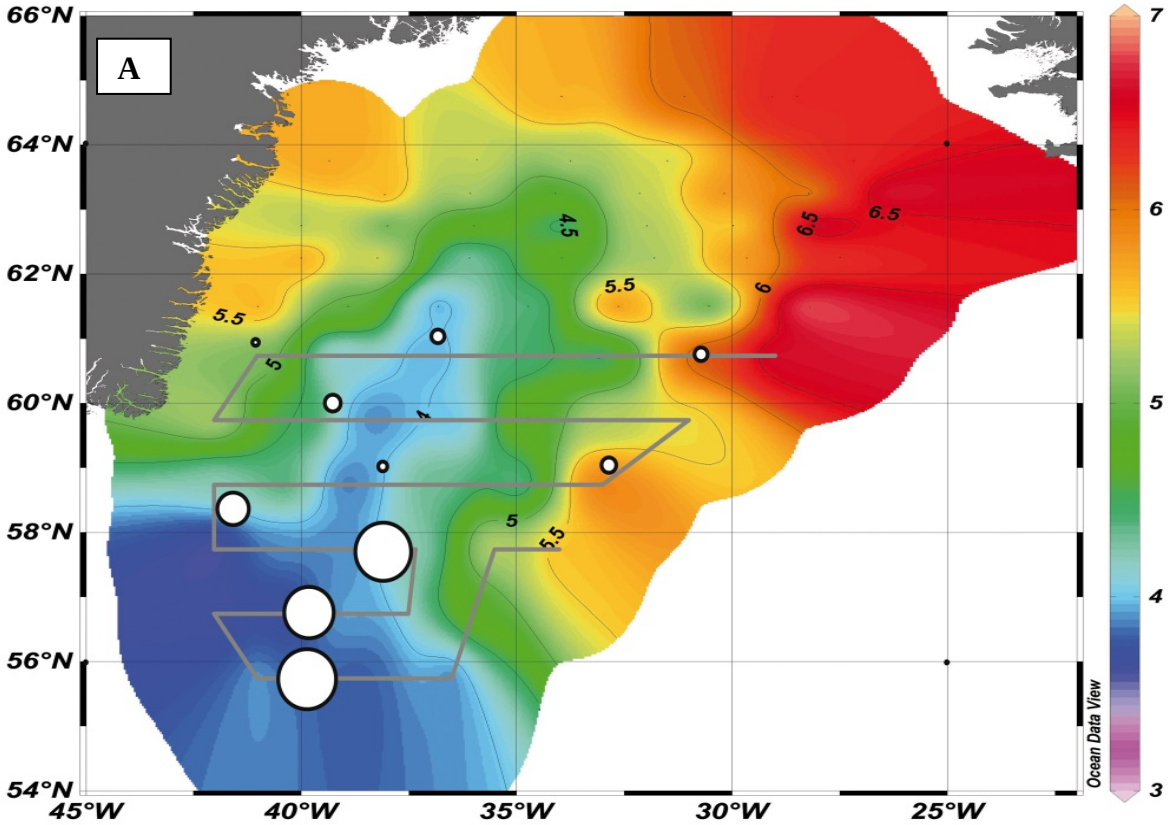



Fig. 1 Results of the hydroacoustic transects (max. $s_A$ – value = 27.9 m²/NM²).



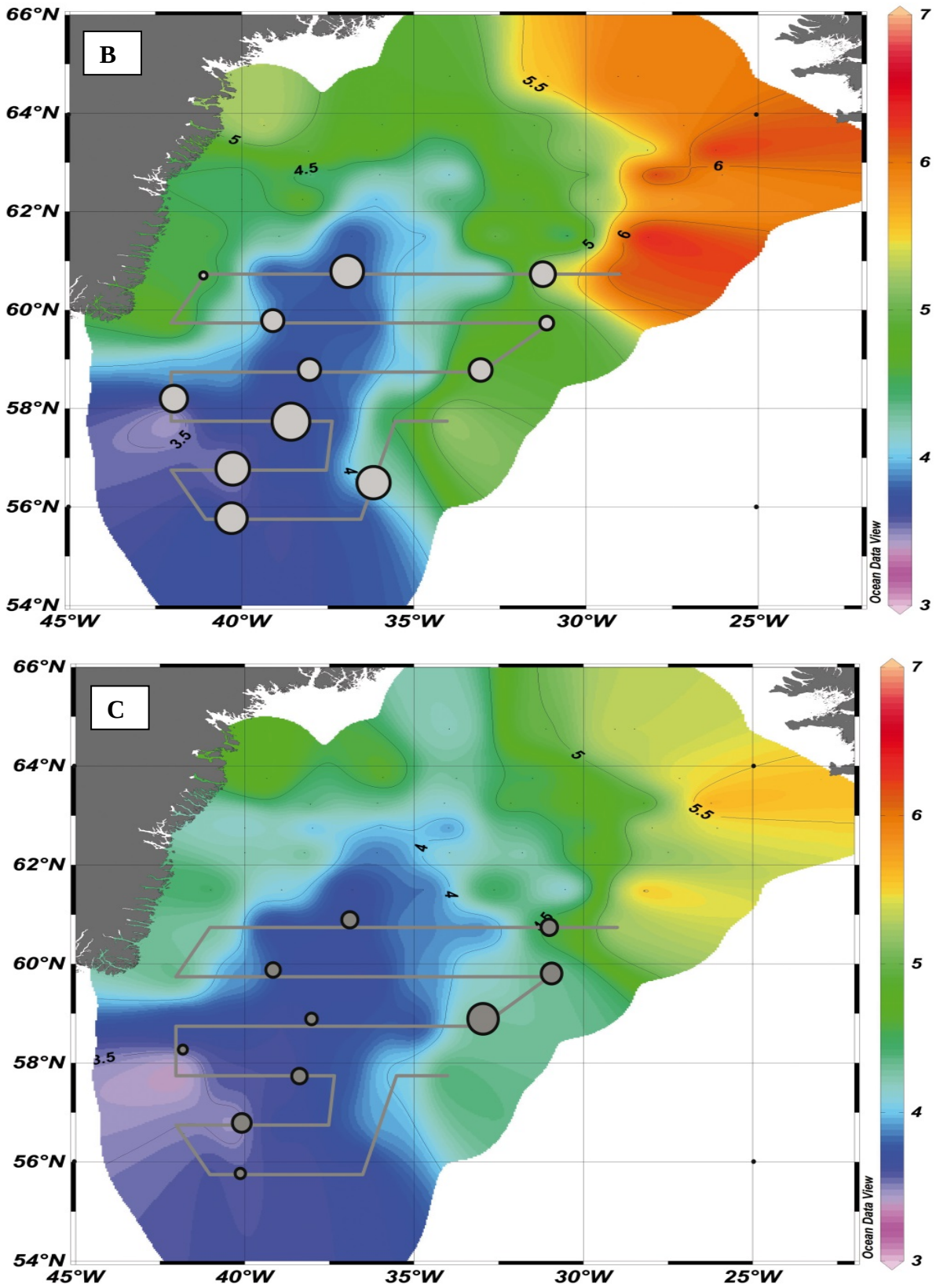



Fig. 2 Redfish catches in the zone above the DSL (A: bright circles), within the DSL but shallower than 500 m (B: grey circles) and below 500 m (C: dark circles) along the cruise track of the “Walther Herwig III”.

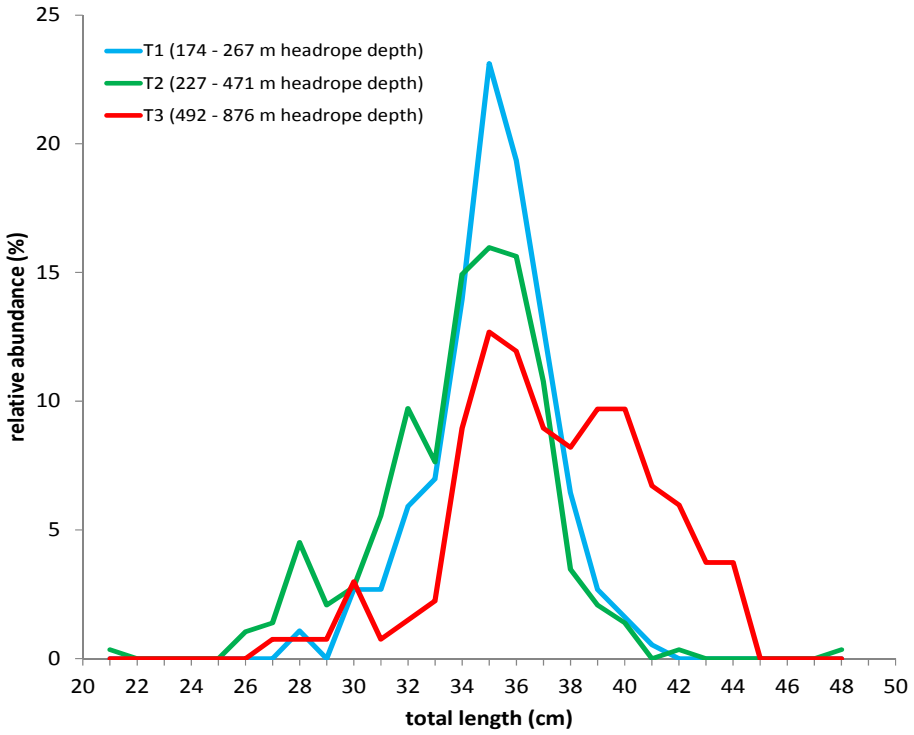



Fig. 3: Length distribution (%) of redfish caught (n=608) in three trawl types.

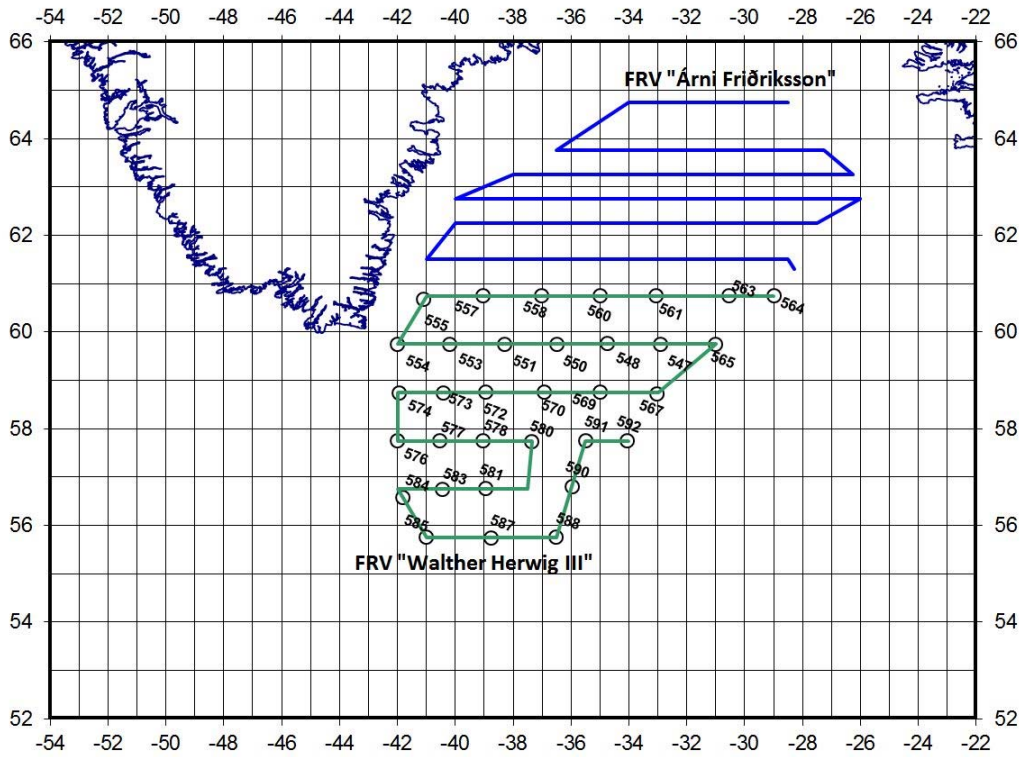



Fig. 4: Positions of the hydrographical stations on the cruise WH385. The blue line indicates the track of the Icelandic vessel ”Arni Friðriksson”.