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Report

Number: 07.010

Cruise report hydro acoustic survey for blue whiting (Micromesistius poutassou) with R.V. “Tridens”, 05 March - 23 March 2007

Sytse Ybema

June 2007

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Summary

This is the report of the Dutch part of the international North East Atlantic hydro acoustic survey for blue whiting. The survey is coordinated by ICES and has been executed annually. Ireland, Russia, Iceland, Denmark, Faroes and Norway also participate in the survey.
The purpose of the survey is to estimate the blue whiting stock of the North East Atlantic. The ICES uses this estimation is as a “tuning index” to assess the North East Atlantic blue whiting stock.
For this survey a Simrad 38kHz splitbeam transducer was used together with a Simrad EK60 echo sounder. The applied method was echo integration. By sailing transects over the survey area, the total acoustic cross-section can be calculated by surface area sampled. Trawling identified species composition of localized schools. The length composition of each species was determined. Blue whiting was examined on age and fecundity from which a split up stock structure was made. Blue whiting where found throughout the survey area associated with the continental shelf edge but showed a clear increase reaching the northern part of the Tridens survey area.

Although a considerable loss of transects due to bad weather conditions, the survey has been successful in terms of acoustic data quality and inter vessel communication. Due to bad equipment Tridens was not able to meet international agreements (PGNAPES) on CTD downcasts.

1. Introduction

Wageningen IMARES, Institute for Marine Resources & Ecosystem Studies participates in the international North East Atlantic hydro acoustic survey for blue whiting since 2004. The survey is part of the EU data collection framework. The aim of this survey is to provide an abundance estimate of the whole North East Atlantic blue whiting population as well as to determine the spatial distribution at this time of year. This estimate is used as a tuning index by ICES to determine the size of the population. In this report the results are presented of the survey west of Ireland, carried out by FRV "Tridens".

In spring 2007, five research vessels representing the Faroe Islands, Ireland, the Netherlands, Norway and Russia surveyed the spawning grounds of blue whiting west of the British Isles. International co-operation allows for wider and more synoptic coverage of the stock and more rational utilisation of resources than uncoordinated national surveys. The survey was the fourth coordinated international blue whiting spawning stock survey since mid-1990s. The primary purpose of the survey was to obtain estimates of blue whiting stock abundance in the main spawning grounds using acoustic methods as well as to collect hydrographic information. Results of all the surveys are also presented in national reports (Atlantida: Shnar et al. 2007; Celtic Explorer: O'Donnell et al. 2007; Eros: Godø et al. 2007; M. Heinason: Jacobsen et al. 2007; Tridens: Ybema et al. 2007).

2. Methods

2.1 Scientific Staff

IMARES staff
1. Sytse Ybema
2. Kees Bakker
3. Thomas Pasterkamp

Guest scientists

1.	Eric Armstrong	(Marine Lab, Scotland)
2.	Dominik Gloe	(BFA, Germany)
3.	Kirsti Eriksen	(IMR, Norway)
4.	Pablo Tjoe-awie	(IMARES)
5.	Dirk Tijssen	(DIFRES, Denmark)

2.2 Narrative

Week 26
On Monday 05 March at 13:00h local time Tridens left the port of Scheveningen and headed towards the Bantry Bay, Ireland. Bad weather conditions made Tridens arrive later than planned at Bantry Bay on Wednesday at 16.00 GMT. Both 38kHz transducers from the towed body and hull mounted were calibrated (for more detailed information see section “Calibration” in the main report). Thursday 08 March at 16:00h Tridens steamed towards the beginning of the first transect (50°.15N / 11°W). All 50.15N, 50.45N, 51.15N, 51.45N, 52.15N transects were covered this week conducting only one haul along the shelf edge. Schools of blue whiting in this area were elongated as expected and their distribution was closely related to the shelf edge. Acoustic data of six hours along a Porcupine transect was mistakenly not recorded

Week 27
It was decided to focus on the shelf edge as most blue whiting was expected here. On the more northern transects blue whiting schools were not as elongated as in the south; the schools were dense and Tridens recorded the most dense school ever recorded in this international survey. Not surprisingly many dealfish were again observed amongst the blue whiting. The weather got worse during the week and 2 days after arrival in Killybegs at Wednesday 22 March 14:00h it was decided that it was too dangerous to resume the survey. Three extra days had to be spend in Killybegs. Our Norwegian colleague had to be dropped off because of illness.

Week 28
Departure from Killybegs was on Tuesday morning 10:00h. A final day was spend on finishing the final miles at the shelf edge at the 54.45N transect. The most western part of this transect as well as the 55.15N and 55.45N had to be covered by the Celtic Explorer due to bad weather time loss earlier that week. During the survey, a system had been developed to actively monitor the acoustic status of the transducers which resulted in no unexpected drop outs of the signal like in previous years. Arrival in Scheveningen on 31 March at 09.00.

2.3 Survey design

The survey was carried out from 5 March to 23 March 2007, covering an area west of Ireland from latitude 50.15° to 54.45° North and from longitude 10.45° West to 16° West (Fig. 2.1). A slightly adapted survey design was applied this time, both based on the blue whiting distribution seen during the previous surveys and the absence of the Norwegian R/V G.O. Sars in the area. Parallel transects along latitudinal lines were used with spacing between the lines set at 30 nm. Acoustic data from transects running north-south close to the shelf edge (that is parallel to the depth isolines) were excluded from the dataset.

Based on previous years' results and after consultation with the PGNAPES members it was decided to compress transects were no blue whiting was to be expected. As previous surveys show fish closely related to the shelf edge west of Porcupine Bank, west going transects in this area were clipped when no fish was observed for several hours. Furthermore, since no fish was observed in areas with water depth below 250m, all transects were cut of at the 200m depth contour. CTD stations were planned in advance but extra stations were added and removed depending on the weather conditions.
The actual surveyed cruise track and trawl positions are presented in figure 2.2.

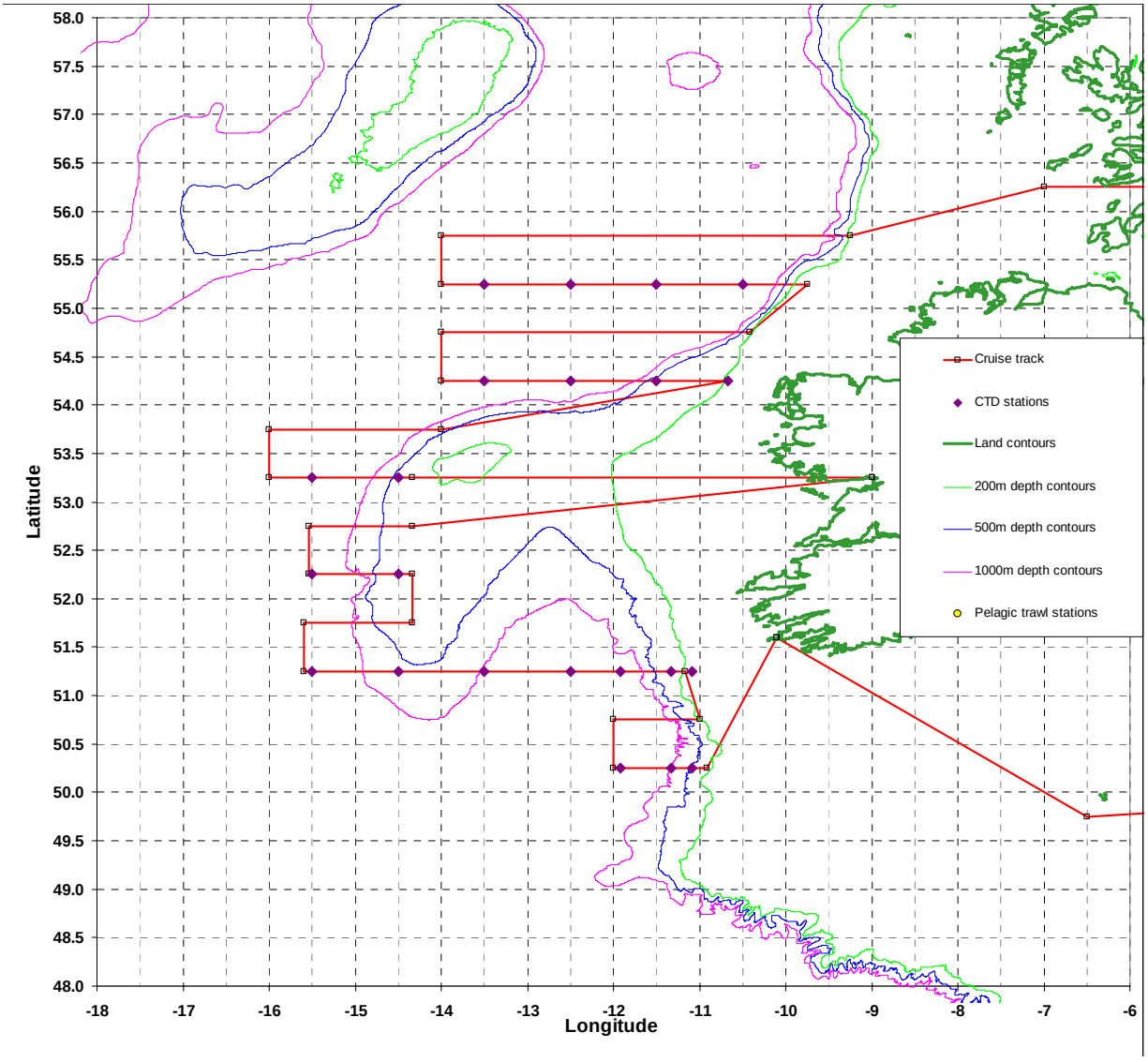

Figure 2.1. Planned cruise tracks and CTD stations. CRD stations are displayed as black dots.

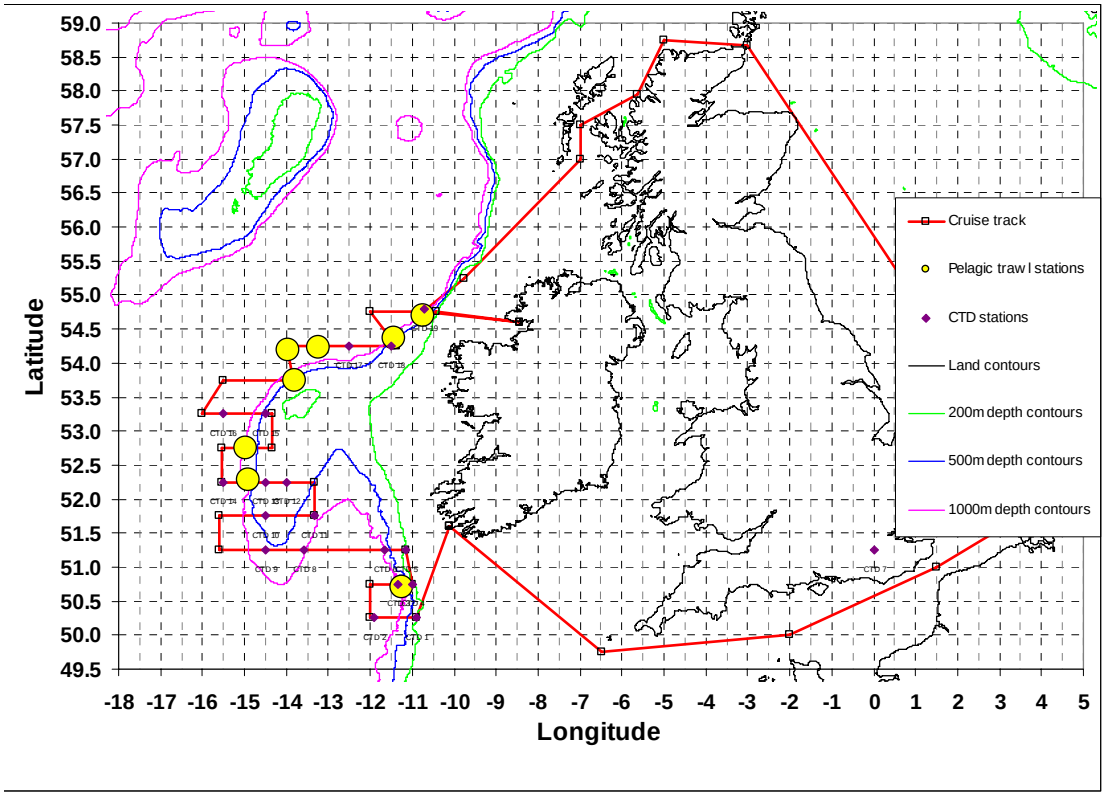

Figure 2.2. Executed cruise track, CTD stations and trawl hauls during the BWHTS 2007.

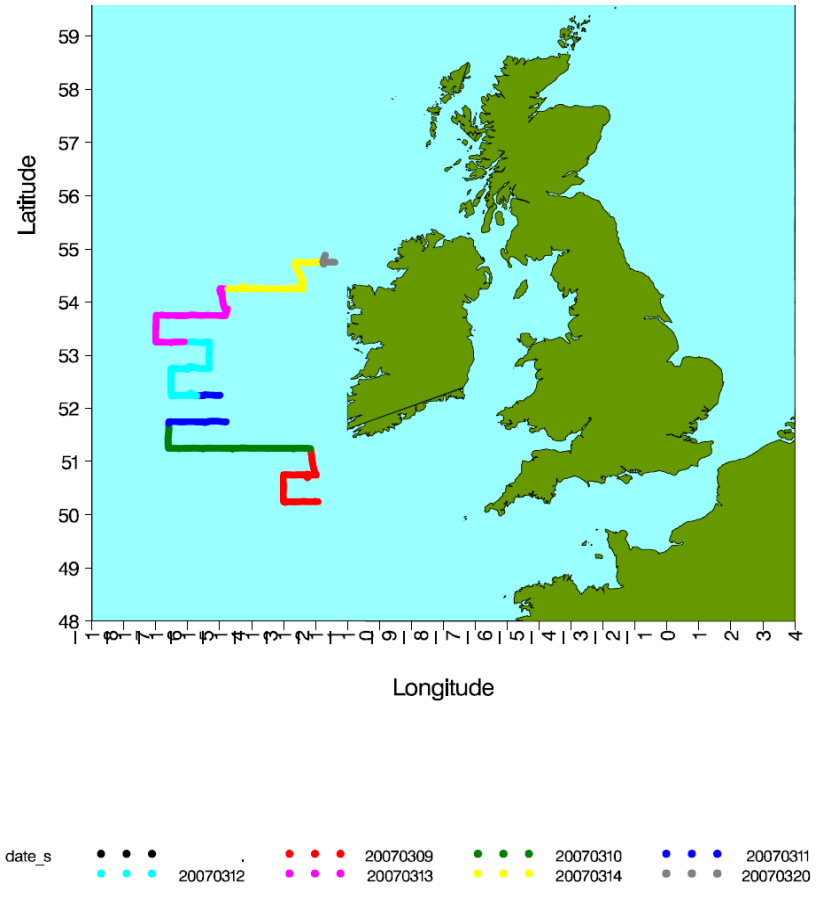

Figure 2.3.1. Temporal progression of the survey, 05 March – 23 March 2007.

2.4 Acoustic calibrations

Both transducers were calibrated in the Bantry Bay, Ireland using results from the first run as an input in the next run. This method had not been applied before but should have been standard. Four calibrations were executed successfully although the weather conditions were bad.

Frequency	transducer	results
38 kHz	Hull mounted	Good
38 kHz	Hull mounted	Good
38 kHz	Towed body	Good
38 kHz	Towed body	Good

A post calibration near Ullapool was executed but rough weather caused too much interference from near surface air bubbles. A downwards extendable transducer setup during calibration is suggested for next year.

2.5 Acoustic data collection

A Simrad 38 kHz split beam transducer was operated in a towed body (type “Shark”) 6-7 m under the water surface. The settings of the EK60 are listed in appendix B. Acoustic data were collected with a Simrad EK60 scientific echo sounder. The data were logged with Sonardata Echoview software. The EK60 received the vessel speed from the ship’s GPS. A variable ping rate was used near the shelf edge avoiding false bottom echoes. The data were logged in 1 nautical mile intervals. A vessel speed of 11 knots was used on one engine without disturbing the acoustic image. The acoustic values (NASC’s) from each log interval were only assigned to the category “blue whiting”. All echoes were recorded with a threshold of -80dB up to a depth of 750 meters below the transducer.
Eric Armstrong, guest scientist from the Marine Lab in Aberdeen assisted in the use of Sonardata Echoview. An algorithm was created used for detection of blue whiting schools. The aim of this exercise was to automated the subjective scrutiny method normally applied.
Furthermore, Echoview was also used to monitor the amount of acoustic energy send by the transducer. In previous years, many unexpected results were caused by unreliable signal cables which couldn’t be monitored during towing of the towed body. This new algorithm allows us to monitor our acoustic circuit closely and in real time.

2.6 Biological data

Acoustic recordings were verified by fishing with a 5600 mesh pelagic trawl with 20 mm meshes in the cod-end. Fishing was carried out when there was doubt about the species composition of recordings observed on the echo sounder and to obtain biological samples of blue whiting. In general, after it was decided to make a tow with a pelagic trawl, the vessel turned and fished back on its track line.
Fish samples were divided into species by weight. Length measurements were taken to the 1.0 cm below for all species. For blue whiting length representative samples were taken for sex, maturity, age (otolith extraction) and weight. Thomas Pasterkamp (IMARES) was given a first training in blue whiting otolith age reading after which he compared his readings with the readings from guest scientist Kirsti Eriksen, an experienced age reader from IMR. In all cases, specimens of non-target species, were frozen and photographed for species determination in the lab. On of the guest scientists, Dominik Gloe from the Federal Research Centre for Fisheries, took the initiative to centralize all information and photographs from deep sea species. Dirk Tijssen (DIFRES) was able to extract otoliths from 15 deal fish documented this method.

The Scantrol FM100 electronic fishmeter was tested for use on blue whiting surveys. It was concluded that this device is of more practical use in the herring acoustic survey where stratified sampling is applied.

2.7 Hydrographical data

All vessels were able to take CTD stations to the depth of 2000 meter or more, except Tridens who only took CTD stations to 650 meters. Hydrographical data have been collected in 18 CTD stations, (Figure 2.2). The CTD device will be calibrated using daily water samples taken at different locations. In addition, some environmental variables were continuously measured by the ships own "Data acquisition system" (DAS). The continuous measuring sensors had not been calibrated and are therefore not used for further analysis.

2.8 Data analysis

Acoustic – biological and hydrographic data were stored in the PGNAPES format. For the first time in this survey, semi automated data fusion was used to create a better overview of the survey progress and to be able to share data amongst research vessels (Fig 2.8.1).This data fusion projects includes not only collected data during the survey but also live environmental data, weather forecasts and other relevant information for this cruise.

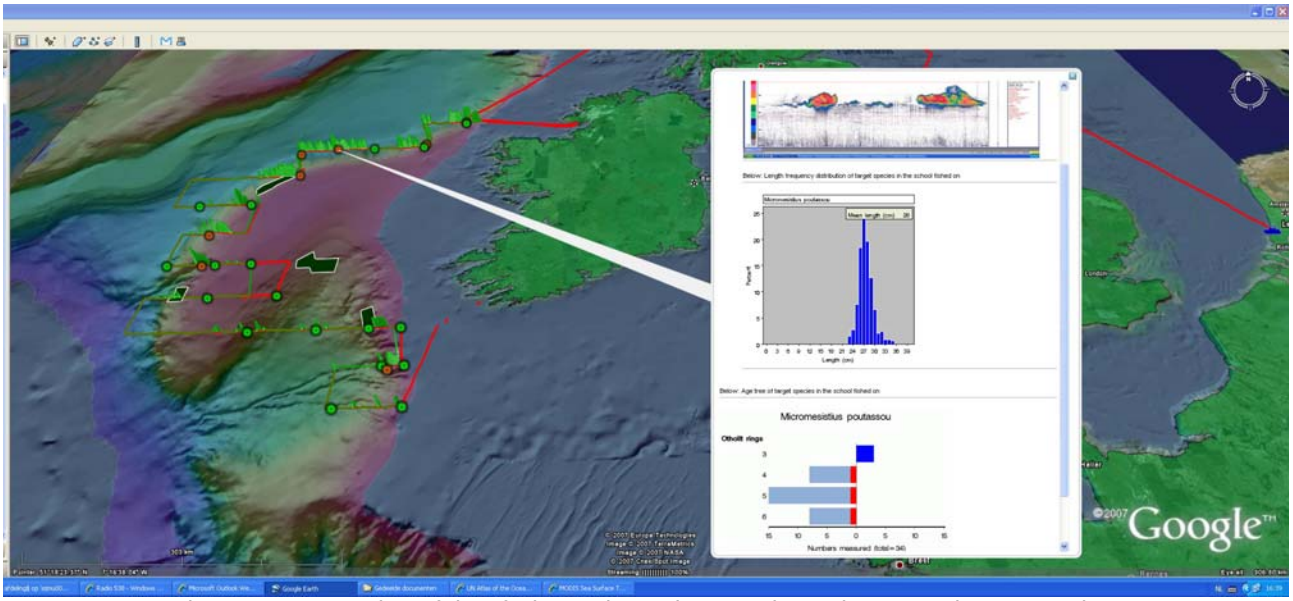

Figure 2.8.1. Overview of data fusion project using Google Earth, 05 March – 23 March 2007.

Further analysis of the international data has taken place in IJmuiden, Netherlands, 18-19 April 2007 resulted in a combined survey report.

3. Results

3.1 Acoustic data results

Detectability

Unlike in previous years, acoustic response of blue whiting was similar shaped in al areas. Some small and dense schools were found (Fig. 3.1.1 B) but the overall pattern was 'eal-like' (Fig. 3.1.1 A and C). In cooperation with the expertise of Eric Armstrong, a blue whiting detection algorithm was created in Sonardata Echoview. Although still in an initial phase, it has been proven being capable of selecting identical schools which would have been selected manually.

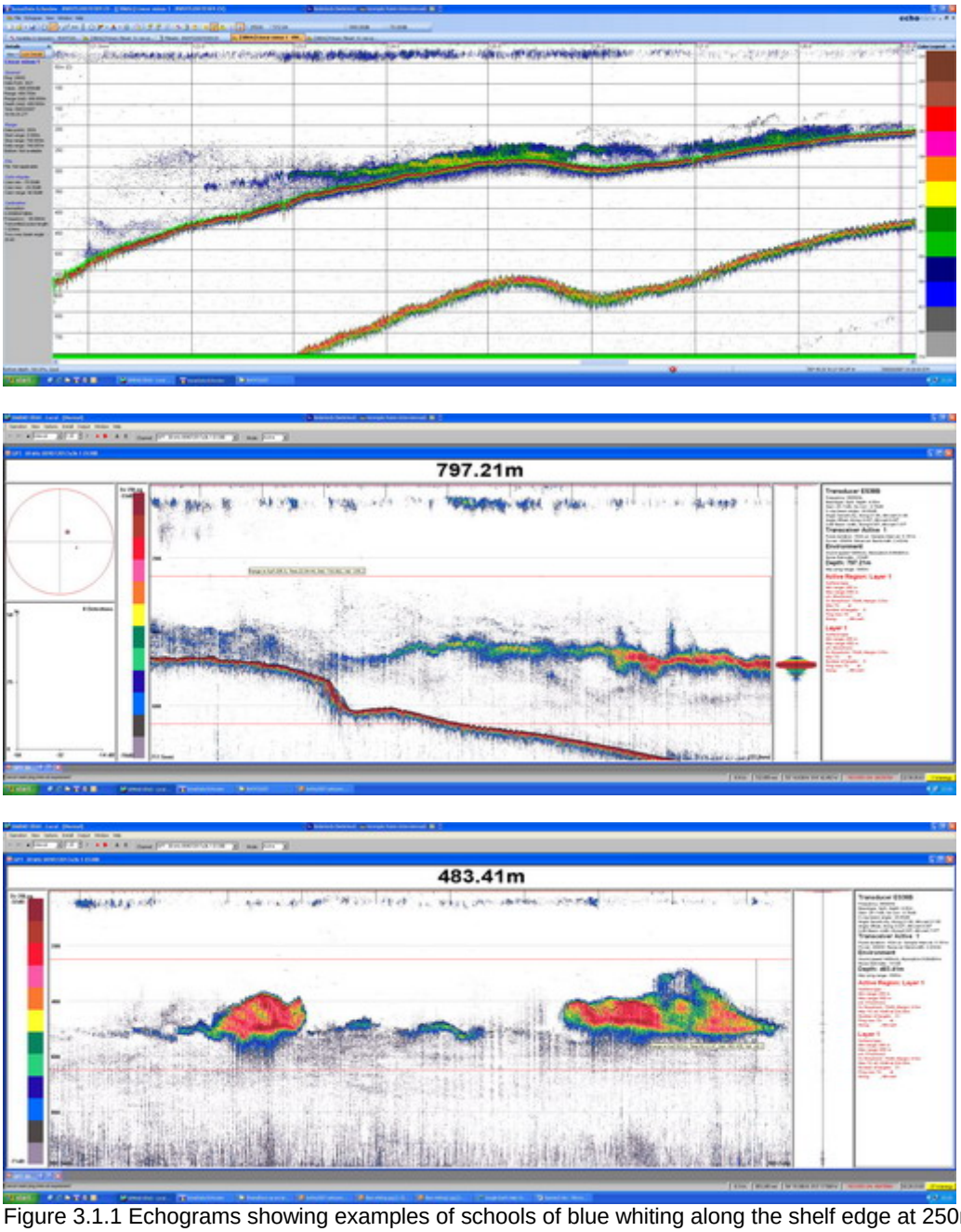

Figure 3.1.1 Echograms showing examples of schools of blue whiting along the shelf edge at 250m depth (upper panel), small dense schools detected at 500m depth (middle panel) and large schools detected (Sa value of 279.000 m^2/nm^2) also at 500m depth further north of Porcupine Bank (lower panel). Recorded at respectively 50º45'N –11º09'W at 9 March, 53º14'N –14º42'W at 12 March and 54º15'N –13º17'W at 14 March 2007.

Horizontal and vertical distribution patterns

Overall, the strongest signals of blue whiting were observed at depths of 450-600m, sometimes extending to around 300m depth (or even shallower) on the slope areas (Fig. 3.1.2). Like in all previous years, schools were found further off the slope area in the northern part of the survey area. In the transboundary region between North and South Porcupine and Rockall sub-areas a notable increase of biomass was recorded in 2007.

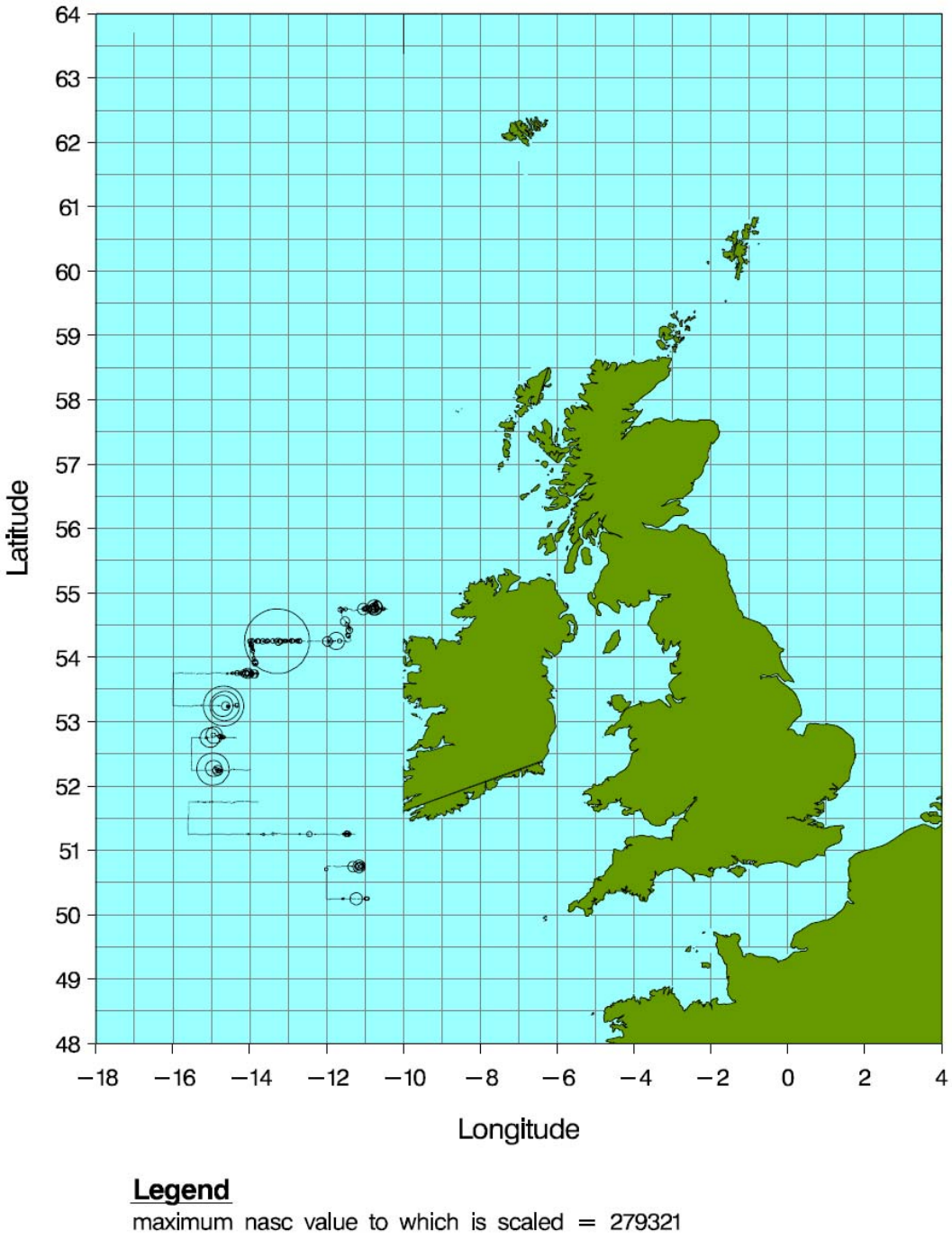

Figure 3.1.2. Post plot showing the distribution of **total blue whiting** NASC values (on a proportional square root scale relative to the largest value of 279.00) obtained during the March 2007 North East Atlantic blue whiting hydro acoustic survey on FRV “Tridens”. The blue line indicates the 500m depth contour.

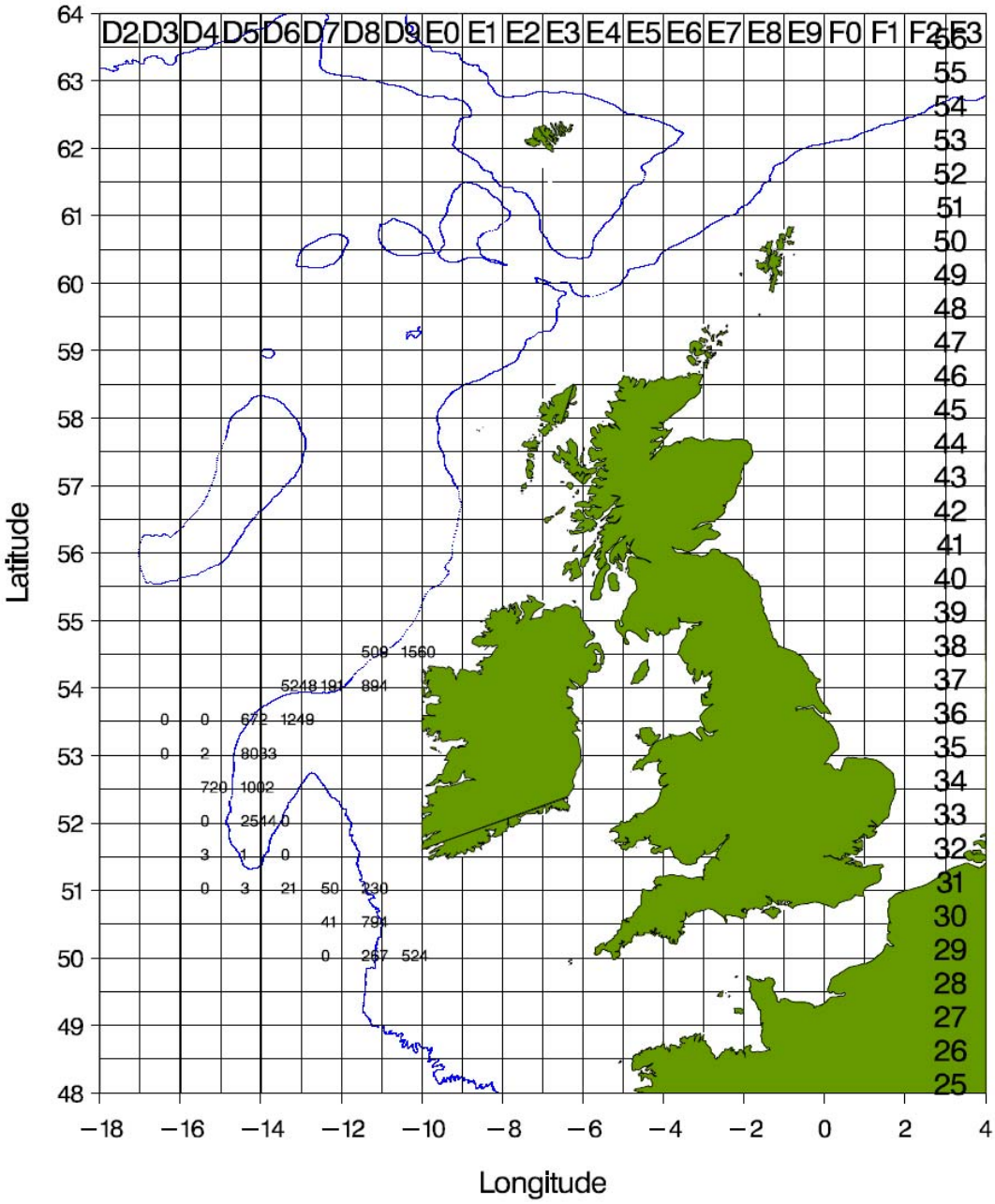

Figure 3.1.3. Mean acoustic density (s_A, m^2/nm^2) **blue whiting** per ICES rectangle obtained during the March 2007 North East Atlantic blue whiting hydro acoustic survey on FRV “Tridens”. The blue line indicates the 500m depth contour.

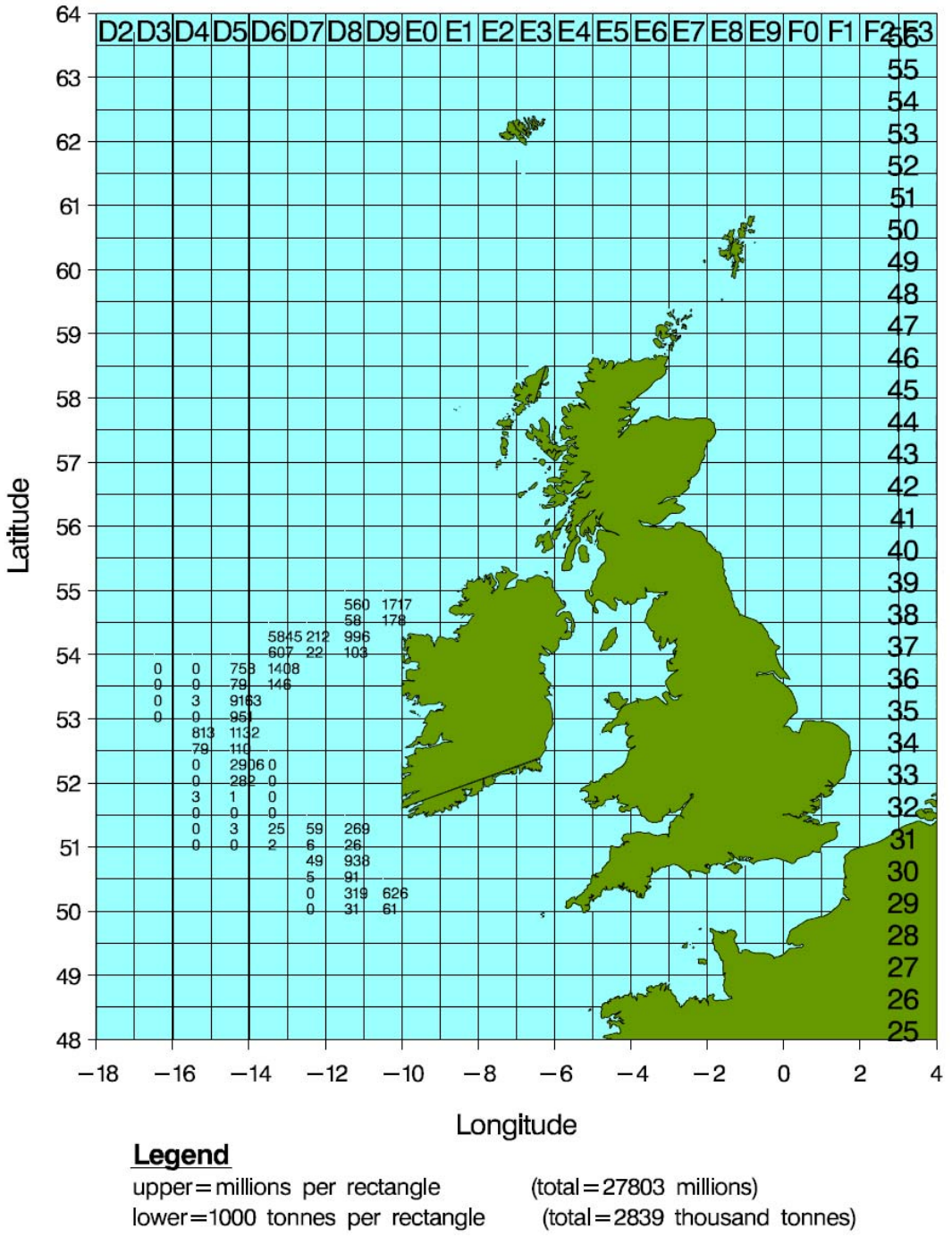

Figure 3.1.4. Total numbers (millions) and total biomass (thousand tonnes) of **blue whiting** per ICES rectangle obtained during the March 2007 North East Atlantic blue whiting hydro acoustic survey on FRV “Tridens”. The blue line indicates the 500m depth contour.

3.2 Trawl data

In all, 8 trawl hauls, all containing blue whiting were conducted (Table 3.2.1). Most hauls were all strongly dominated by blue whiting as shown in table 3.2.2. As in previous years, Deal fish were observed throughout the catches, 20 in total.

Table 3.2.1. Details of the trawl hauls taken during the March 2007 North East Atlantic hydro acoustic survey, FRV "Tridens".

haul	sample	validity	ICES rectangle	date	time GMT	position	haul_duration (min)	depth (m)	gear depth (m)	wind direction (deg)	wind force (Bf)	total sample weight (kg)
1	5400126	valid	30D8	09/03/2007	16:52	50.42N-11.14W	99	884	430	270	5	n.a.
2	5400127	valid	33D5	12/03/2007	01:49	52.14N-14.52W	39	856	340	225	4	4059
3	5400128	valid	34D4	12/03/2007	13:18	52.44N-15.01W	49	900	459	270	6	485
4	5400129	valid	36D6	13/03/2007	16:04	53.46N-13.48W	120	681	500	270	4	33
5	5400130	valid	37D6	13/03/2007	20:50	54.11N-13.58W	64	2413	520	180	4	68
6	5400131	valid	37D6	14/03/2007	02:57	54.16N-13.15W	107	2000	500	270	4	2067
7	5400132	valid	37D8	14/03/2007	15:02	54.18N-11.28W	84	900	500	225	9	2211
8	5400133	valid	38D9	20/03/2007	14:56	54.45N-10.45W	58	1700	494	315	3	n.a.

Table 3.2.2 Trawl catches during the March 2007 North East Atlantic hydro acoustic survey, FRV "Tridens" in kg. Scientific and English species names are listed in appendix C.

	5400126	5400127	5400128	5400129	5400130	5400131	5400132	5400133
Argyropelecus gigas					0.0			
Blackfish								0.4
Blue whiting	5161.9	4059.0	582.0	33.3	67.5	2066.9	2213.3	2325.0
Deal-fish			1.3	17.7	21.1	1.8		14.2
Greater argentine								
Hachetfish	0.0		0.2	1.6	0.2		0.2	
Mackerel				1.6				
Myctophidae	0.0	0.1	0.3	4.6	2.6	0.1	0.0	0.1
Notolepis rissoi			0.1					
Sagittal squid								
Silver pomfret						0.4		
Snake pipefish	0.0		0.1	0.0	0.0	0.0	0.0	0.2

Table 3.2.3. Length frequency numbers of blue whiting by haul during the March 2007 North East Atlantic hydro acoustic survey, FRV "Tridens".

length class	5400126	5400127	5400128	5400129	5400130	5400131	5400132	5400133
20					0			
21	1				4			
22	2		1	0	3		0	0
23	5				2	2	3	1
24	4	1	1	1	3	3	3	5
25	8	6	10	1	13	8	6	13
26	14	22	20	4	23	18	9	19
27	18	30	23	10	22	24	25	22
28	25	18	23	11	13	20	20	15
29	12	7	10	21	7	13	12	13
30	5	5	6	15	5	7	12	7
31	3	4	1	17	2	2	4	2
32	3	2	2	10	1	2	2	2
33	1	2	1	8		1	2	0
34	0	1	0	2	0	1	1	1
35		0	1	1		1		
36		0	1					
37						0		
38			0					

Length frequency distributions per haul of blue whiting caught are shown in figure 3.2.1.

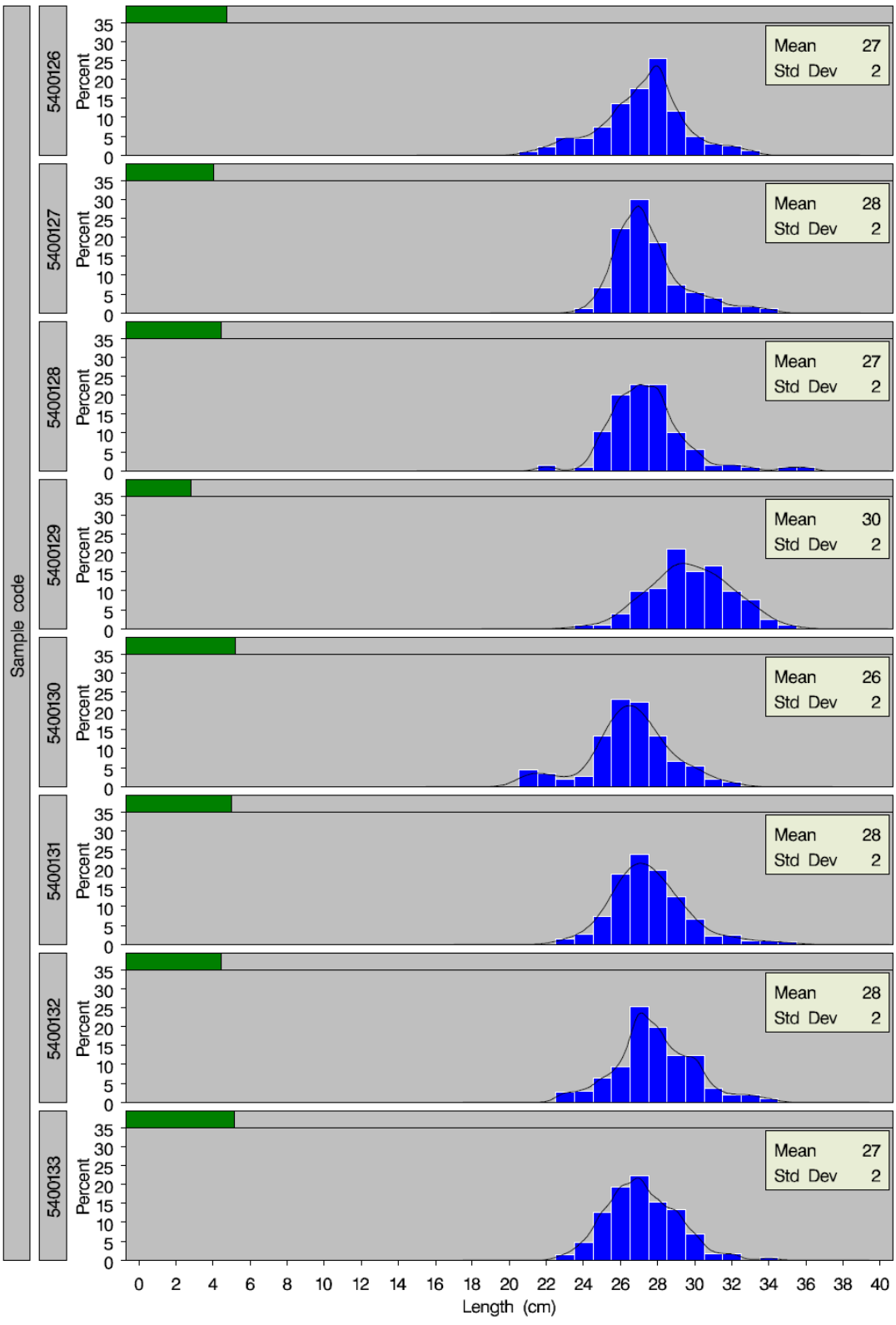

Figure 3.2.1. Length frequency distributions of blue whiting. Smoothing is obtained by normal kernel density estimates. The green bars indicate the relative amount of samples used.

3.3 Biological data

In total 400 biological samples of blue whiting were collected and used for length, age and maturity keys. An overview of these samples is shown below (Table 3.3.1). Stock in the Tridens survey area is dominated by age classes 4 and 5 years (year classes 2003 and 2002).

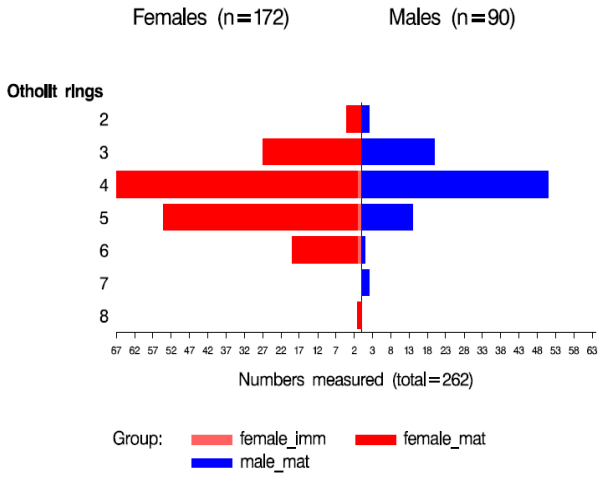

Figure 3.3.1 Overview of collected biological samples of blue whiting by haul during the March 2007 North East Atlantic hydro acoustic survey, FRV “Tridens”.

Growth

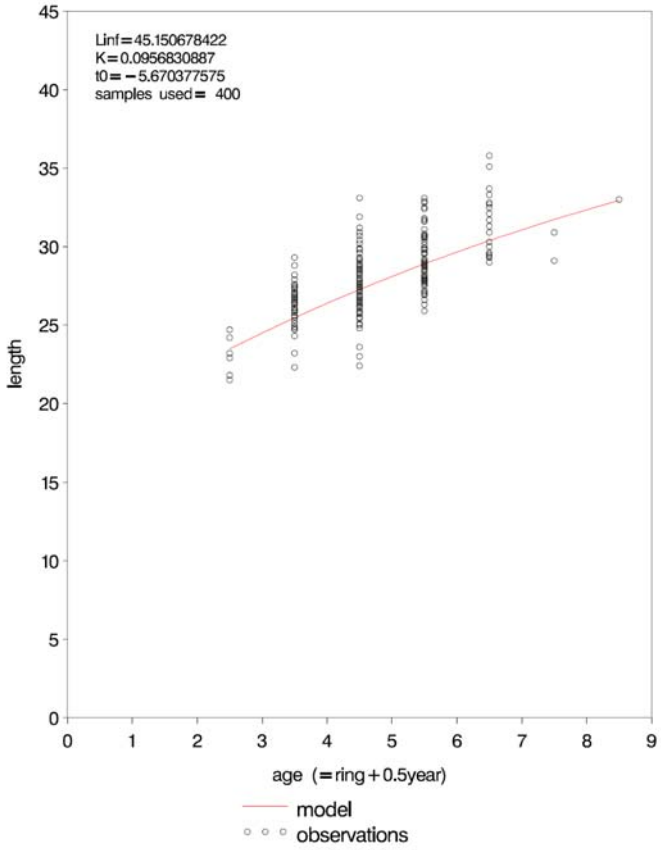

Figure 3.3.2 Von Bertalanffy growth curve.

3.4 CTD data & data acquisition system

Due to insufficient observations no data is available at present time.

4. Practical remarks

Organisation/communication
It should be noticed that communication problems have lead to undesirable and even questionable safety situations in the first part of the survey.
Overall, several improvements were suggested for this cruise from which some were implemented. However, in some distinct cases, it still remains unclear to which extend the vessel owner should provide scientists with its own equipment present.

The use of internet is becoming more important for both scientists and crew members onboard. There is a strong need for clear rules/priorities on both current and future use and on the site technical support when this service crashes (which still happens at unexpected moments). This latter issue also includes more technical devices on which we rely more and more like the GPS system. Not being able to monitor which computer uses large amounts of bandwidth has been the reason for not sharing data amongst research vessels involved.

Safety
It remains unclear if safety shoes are required throughout the survey.
The front deck, which is used during calibration, is slippery and could cause dangerous situations.
Other safety issues will be handled within the IMARES survey group.

Data quality and continuity
By selecting (guest) researchers on their specific knowledge we were able to improve data quality and task efficiency:

1. Scientists were trained in technical work, age reading and acoustic data analysis.
2. Acoustic signal malfunctioning could be monitored for the first time. This protocol will be included in the PGNAPES acoustic manual. Furthermore, a start has been made in automating blue whiting detecting on the echogram.
3. A photo collection of species which are frequently encountered during this survey was created and will be merged with other national photo guides and implemented into the PGNAPES survey manual.

More practical issues for future work are listed below:

- Otolith containers manufactured In Iceland were more practical to use and preserved otoliths in a better way. It should be considered to use those for all surveys and market sampling.
- More containers for storing fish should be brought next survey.
- Acoustic calibrations were performed using a different protocol resulting in better data quality. This protocol should be included in the survey manual.
- It remained unclear for a few days how to configure PC's without interfering data recording. The cause could not be found.
- "Trim**o**n" sensor recording software was running stable.
- "Trim**a**n" trawllist writing software is running stable and the next step will be to automate 'adding more variables' in the electronic trawllist. Some weak points of this software:
    - It relies on "akwidata" text file which is generated by "Trimon" sensor reading software. No columns should be removed from this file; columns can only be added.
    - A weak location in data collection is still the drop out of onboard sensors. The software cannot handle this yet.
    - The software needs manual selected network settings and the location of the "Akwidata file"
    - Look-up tables are copied from "Billie" fish recording software. Any update in these tables requires updates in "Triman".

- The ships main research computer should be password protected to prevent loss of data.
- A low priority was given for replacing the CTD winch and cable. Instead of the required 1000m Tridens was only able to use approximately 650m and had to drop several CTD downcast stations as a result.
- The cable to the towed body was damaged like in any other year. It needs to be stressed that a new, less effort consuming and more sustainable setup is highly required.

Appendix A. Calibration results

```
#  Date:  08/03/2007
#
#  Comments:
#    BWHTS 2007 Bantry Bay cal 2
#
#  Reference Target:
#    TS                -33.60 dB       Min. Distance         13.00 m
#    TS Deviation        8.0 dB        Max. Distance         16.00 m
#
#  Transducer:  ES38B  Serial No.   30501
#    Frequency           38000 Hz      Beamtype               Split
#    Gain               25.12 dB       Two Way Beam Angle   -20.6 dB
#    Athw. Angle Sens.      21.90      Along. Angle Sens.      21.90
#    Athw. Beam Angle     6.96 deg      Along. Beam Angle     6.99 deg
#    Athw. Offset Angle  -0.04 deg      Along. Offset Angle -0.05 deg
#    SaCorrection        -0.67 dB       Depth                 0.00  m
#
#  Transceiver:  GPT  38 kHz 009072017a3b 1 ES38B
#    Pulse Duration       1.024 ms      Sample Interval     0.191   m
#    Power               2000  W       Receiver Bandwidth   2.43 kHz
#
#  Sounder Type:
#    EK60 Version  2.1.1
#
#  TS Detection:
#    Min. Value          -50.0 dB       Min. Spacing           100 %
#    Max. Beam Comp.       6.0 dB       Min. Echolength         80 %
#    Max. Phase Dev.         5.9        Max. Echolength        180 %
#
#  Environment:
#    Absorption Coeff.   9.7 dB/km      Sound Velocity     1489.2 m/s
#
#  Beam Model results:
#    Transducer Gain    = 25.11 dB      SaCorrection       = -0.76 dB
#    Athw. Beam Angle   = 7.07 deg      Along. Beam Angle  = 6.93 deg
#    Athw. Offset Angle =-0.00 deg      Along. Offset Angle=-0.02 deg
#
#  Data deviation from beam model:
#    RMS =    0.19 dB
#    Max =    0.41 dB  No. =   363  Athw. = -1.8 deg  Along = -3.7 deg
#    Min =   -0.79 dB  No. =   392  Athw. = -0.2 deg  Along = -2.3 deg
#
#  Data deviation from polynomial model:
#    RMS =    0.17 dB
#    Max =    0.38 dB  No. =   379  Athw. =  2.0 deg  Along = -4.4 deg
#    Min =   -0.75 dB  No. =   392  Athw. = -0.2 deg  Along = -2.3 deg
```

Appendix B. EK60 settings

Transceiver menu	
Absorption coefficient	9.7 dB/km
SA correction	-0.67 dB
Pulse length	1.024 ms
Bandwidth	2.43 kHz
Max Power	2000 W
Two-way beam angle	-20.6 dB
3 dB Beam width	6.99 dg
Calibration details	
TS of sphere	-33.6 dB
Range to sphere in calibration	14.00 m
Transducer gain	25.11 dB
Calibration factor for NASC's	-
Log/Navigation Menu	
Speed, position, vessel log	Serial from ship's GPS
Operation Menu	
Ping interval (s)	VAR
Display/Printer Menu	
TVG	20 log R
Integration line	N/A
TS colour min.	-50 dB
Sv colour min.	-70 dB

Appendix C. Species names

three letter code	NODC_code	tsn	Dutch_name	Scientific_name	English_name
ARG	8756010203	162064	Grote zilversmelt	Argentina silus	Greater argentine
	8759020105	162218	Grote bijlvis	Argyropelecus gigas	
	8759020107	162220	Bijlvis	Argyropelecus olfersi	Hachetfish
	8851010301	172520	Zwarte vis	Centrolophus niger	Blackfish
AZN	8820022101	166591	Adderzeenaald	Entelurus aequoraeus	Snake pipefish
WHB	8791032201	164774	Blauwe wijting	Micromesistius poutassou	Blue whiting
	8762140000	162575	Lantaarnvissen	Myctophidae	
	8762070201	162471	Risso's barracudina	Notolepis rissoi	
	8835710301	170297	Zilverbraam	Pterycombus brama	Silver pomfret
MAC	8850030302	172414	Makreel	Scomber scombrus	Mackerel
TSAG	5707150102	82526	Rode pijlinktvis	Todarodes sagittatus	Sagittal squid
DEA	8815020102	166342	Bandvis	Trachipterus arcticus	Deal-fish

Appendix D. Length frequency proportions of most abundant species