

Irish Blue Whiting Acoustic Survey Cruise Report ICES Divisions VIa & VIb

March - April 2006

RV CELTIC EXPLORER



Report by

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Introduction

Acoustic surveys on the blue whiting (*Micromesistius poutassou*) stock in the north east atlantic have been carried out since the early 1970s by the Institute of Marine Research (IMR), Norway. In the early 1980s a coordinated acoustic survey approach was adopted, with both Russia and Norway participating to estimate the size of the combined stock. The acoustic survey programme is carried out for fishery management purposes and is continued to date. Results of this annual spawning stock assessment combined with juvenile surveys and commercial catch at age data are presented annually at the ICES led Northern Pelagic and Blue Whiting Fisheries Working Group. Ultimately, from this combined scientific data, management and catch advice is determined for the following year.

The highly migratory nature of the combined stock requires a large geographical area to be surveyed during a protracted spawning period. Consequently Acoustic surveys are routinely carried out on specific spawning and post-spawning aggregations of blue whiting. To facilitate a more coordinated spatio-temporal approach to spawning stock assessment, several nations became involved in the PGNAPES coordinated survey programme in 2004. Ireland is one of these nations involved in this annual survey.

The 2006 survey was part of an International collaborative survey coordinated by the Institute of Marine Research, Bergen, Norway, using the vessel the RV “*G.O. Sars*”. Also participating were the RV “*Atlantniro*” (Russia), RV “*Tridens*” (RIVO, Netherlands) the RV “*Magnus Heinason*” (Faroes) and RV “*Celtic Explorer*” (Ireland).

The total combined area surveyed in 2006 covered from the Faroe Islands in the north (62° of longitude) to the southern coast of Ireland (51° N), area coverage to the west extended from 4°-18° of latitude. The Irish component of the survey was made up of transects covering some 2,632 nautical miles (Figure 1). In addition to the collection of acoustic data, fishing hauls were carried out to determine the make up of fish marks recorded by the equipment and to assess the length, weight, age, sex and maturity of the stock. Oceanographic data was collected using a number of spaced hydrographic stations where salinity and temperature of the water column was recorded at depths down to 800m.

Materials and Methods

Survey design and area coverage

The 2006 survey area extended from the south Rockall Trough as the southern limit (55° N), west of the Rockall Bank (18° W), northerly extension reached to the Hatton Bank (60° N) and the easterly extension to mid Rockall Trough ($11^{\circ}25$ W). In total some 2125 nmi (nautical miles) of acoustic transects were carried out, relating to a total area coverage of some 60,000 nmi².

An East-West and North-South transect design was employed. Transects were positioned to cross over the banks at an angle perpendicular to the depth contours, so as not to run in the same direction as the expected occurrence of spawning and migration of post spawning blue whiting. The survey was started in the south and worked in a northerly direction.

Acoustic data acquisition

Equipment settings for the acoustic equipment were determined before the start of the survey program and were based on established settings employed by FSS on previous surveys. The settings used on the *Celtic Explorer* acoustic array are shown in Table 1.

The acoustic data were collected using the Simrad ER60 scientific echosounder. The Simrad ES-38B (38 KHz) split-beam transducer is mounted within the vessels drop keel and lowered to the working depth of 3m below the vessels hull or 8.8m below the sea surface.

While on the survey track the vessel was cruising using DC twin electric motor propulsion, supplied from 1 main diesel engine, so in effect providing “silent cruising” as compared to normal operations (ICES, 2002). However, it should be noted that during fishing operations normal 2 engine operations were employed to provide sufficient power to tow the net.

Acoustic data were observed and recorded onto the hard-drive of the processing unit using the equipment settings from previous surveys (Table 1). The “RAW files” were logged via a continuous Ethernet connection as “EK5” files to the vessels server and the ER60 hard drive as a backup in the event of data loss. In addition, as a further back up a hard copy was stored on DVD. Sonar Data’s Echoview® Echolog (Version 3.0.8) live viewer was used to display the echogram during data collection to allow the scientists to scroll through echograms noting the locations and depths of fish shoals. The equipment was monitored continually by a member of the scientific crew. Any off track time was recorded.

Calibration of Acoustic equipment

Keel mounted transducers

Calibration of the ER 60 keel mounted transducer array was carried out in Killary Harbour Co. Galway on the 22nd March. See Table 1 for the instrument settings adopted during the survey. The ER 60 was last calibrated in October 2005.

The 38 KHz transducer was calibrated using a standard target copper sphere (60mm). The 200 KHz frequency was attempted using a 38.1mm tungsten carbide standard target sphere but was aborted due to tide effects and operational difficulties. Estimates of blue whiting abundance were generated solely from data acquired through the 38 KHz transducer.

Results of the calibration (RMS values) were well within Simrad guidelines for all frequencies. For a more detailed description of the calibration of acoustic instruments please refer to Foote *et al*, 1987.

Intervessel Calibration

An Intercalibration was planned to be carried out between the *Celtic Explorer* and the *GO Sars* during the survey in an area where the vessels were close and of good fish registrations. Unfortunately due to severe weather and unsuitable fish registrations when the vessels were close the planned Intercalibration was cancelled. This was also the case for the research vessels *Atlantniro* and *Tridens*.

Biological sampling

Trawl hauls were carried out to determine the identity of insonified fish marks and to ground-truth the data from the ER 60 (See Figure 1 and Table 2). Decisions to fish on particular echo-traces were largely subjective and an attempt was made to target marks in all areas of concentration not just high density shoals. No bottom trawl samples were taken and as a result samples were restricted to marks occurring greater than 5 m from the seabed on the shelf edge.

A single pelagic midwater trawl with the dimensions of 82m in length (LOA) and 73m at the wings ends and a fishing circle of 768 m was employed during the survey (Figure 7). Mesh size in the wings was 12.8 m through to 5 cm in the cod-end. The net was fished with a vertical mouth opening of approximately 48 m, which was observed using a cable linked Furuno netsonde (50 kHz). Spread between the trawl doors was monitored using Scanmar distance sensors, all sensors being viewed through the Scanmar Scanbas system.

Fish samples were divided into species composition by weight. Species other than the blue whiting were weighed as a component of the catch. Measurements of blue whiting lengths were taken to the nearest 0.5 cm. Age, length, weight, sex, maturity and stomach fullness data were recorded for 50 blue whiting within a random 150-250 fish sample from each trawl haul. A further random 100 or 200 fish were taken and processed for length and weight analysis.

Biomass estimation

Acoustic data was backed up every 24 hrs and scrutinised using Sonardata's Echoview (V 3.0.8) post processing software for the previous days work. Data was partitioned into the following categories: plankton (<120 m depth layer), mesopelagic species, blue whiting and bottom fish. Partitioning of data into the above categories was largely subjective and was carried out by 3 scientists experienced in viewing echograms.

The concept of the coordinated survey was to produce a combined estimate of the blue whiting spawning stock size. The data collected onboard was also used to create an independent estimate for the Irish survey of both total and SSB biomass for blue whiting. For the purposes of abundance estimation the survey area for the Irish vessel was classified as one area:

Core area 1(b): Rockall/Hatton

With the following methodology employed:

The surveyed area covered was from 55°N to 60°N and 11°25'W to 18°W. The area was then further subdivided into rectangles of 1° latitude by 2° longitude, as employed for the combined survey estimate. The core areas are based on agreement at the PGNAPES meeting in Galway in August 2005.

S_A values of blue whiting were extracted from Echoview and used to produce a map of estimates of biomass and abundance per 5 nmi log interval on each transect. A zero line of distribution was then formed. Mean S_A per area of rectangle within these lines of distribution was then allocated. Data on length distribution and individual weights of blue whiting were used to produce mean values for each trawl haul and assigned to each assessment rectangle as deemed appropriate. These data were then combined with age and maturity data from the same samples to produce an age-length key for the surveyed stock.

The target strength (TS) used was:

$TS = 21.8 \log L - 72.9 \text{ dB}$, where L is fish length in cm.

The numbers of fish per rectangle were calculated from;

$$N = S_A \times \text{Rectangle area (m}^2\text{)} \times \text{Density Coefficient (1.488 * 10}^6 \text{ * } L^{-2.18}\text{)}.$$

Multiplying the number generated with corresponding mean weight values from trawl samples provides the biomass of individuals in weight.

For a more detailed description of the methodology employed see Anon (Monstad *et al*), 1982.

Inter-Vessel Coordination

It was decided during the PGNAPES meeting in Galway, August 2005, that the 'Celtic Explorer' would take the role as coordinating vessel, sharing information between research vessels. This included a twice weekly news bulletin of information such as the location of each research vessel and information on own fleet activity, fishery operations, fish locations, etc; see Appendix 1

Hydrographics

Hydrographic casts were carried out during the survey at predetermined locations along the track (Figure 1). Data on temperature, depth and conductivity were collected using a Seabird 911 rosette sampler at 5m subsurface and at 1m intervals to within 20-50 m of the seabed, to a maximum depth of 800m.

Marine Mammal and Seabird counts

During the survey a daylight watch on marine mammal and seabird sightings was taken from the bridge.

Cetacean and seabird observations were carried out from the bridge (12m above sea level), watch effort was focused on an area dead ahead of the vessel and 45° to either side. Sightings of Cetaceans in an area up to 90° either side of the vessel bow to beam were recorded and used to confirm features such as species identification, group size and behaviour. The area was constantly scanned during these hours by eye and with water-resistant binoculars (*LEICA* 10x42). Ships position, course and speed were recorded, environmental conditions were recorded every 15 minutes and included, sea state; visibility; cloud cover; swell height; precipitation; wind speed & wind direction. For each Cetacean sighting, the following data were recorded: time; location; species; distance; bearing; number of animals (adults, juveniles and calves) and behaviour. Relative abundance (RA) of cetaceans was calculated in terms of number of animals sighted per hour surveyed (aph). RA calculations for porpoise, dolphin species and minke whales were made using data collected in \leq Beaufort sea state 3. RA calculations for large whale species were made using data collected in \leq Beaufort sea state 5.

For seabird counts a similar methodology was adopted. Visual scans were conducted with the naked eye in a 90° bow-to-beam sector forward of the ship, concentrating on a 300m-wide strip, from which seabird density estimates may be calculated.

Results

Intercalibration

No intercalibration took place between *Celtic Explorer* and *GO Sars*.

Biological sampling

A total of 17 trawl hauls were carried out of the course of the survey (Figure 1 and Table 2) and a total of 19 fish species were encountered (Table 3, Appendix 2). A total of 5 trawls took place in the Rockall Trough, 5 on the Rockall Bank, 4 trawls on the Hatton and George Bligh Banks and 2 in deepwater in the Northern part of the survey area.

Biomass estimate

Fish distribution

Results indicate blue whiting to be most abundant in the surveyed area approaching the edge of banks like Rockall and spread out over the top of certain banks like Hatton >500m. There was also an offshore distribution, especially North-west of the Anton Dorn seamount in the Rockall Trough (Figure 2). Blue whiting were encountered on 19 of the 20 survey transects. The greatest concentrations found throughout the survey were midwater between 400-600 m depth contours. Towards the edge of banks fish were sometimes observed to almost merge with the bottom as depths approached 500m and continued on for sometime as a “blue dust” to an upper limit of 300m (Figure 3d).

The highest registrations were encountered in the Rockall Trough especially North west and west of the Anton Dorn Seamount. Although it had the highest registrations usually associated with spawning fish, the majority of fish were spent (Figure 3b). There was also the presence of a fishing fleet of Dutch and Norwegian vessels in this area with some vessels reporting long tow times for small amounts of fish. Shoals are not as dense when fish are spent and are harder to catch when trawling.

The area north of 58°N contained reasonable amounts of blue whiting. This is probably because of their annual migration north at this time of the year, probably from the west side of Rockall. There was also presence of a fishing fleet of Russian and Faroese trawlers in this area in particular north west of the George Bligh Bank. Blue whiting was registered on every transect in this northern area. Although not dense they covered a wide area.

The area to the south of the survey area contained the least amount of fish. Therefore this is a consequence of timing rather than a reflection on abundance in this area.

Juvenile fish were found along the 300-450m contours in the southern and western slopes of the Rockall bank and also on the 500m contour on the George Bligh Bank. These juvenile fish are probably resident on these banks for most of the year.

Estimation of Stock Size

The estimate for total abundance of blue whiting from the Irish survey 2006 is;

	TSB (1000 tonnes)	SSB (1000 tonnes)
Area 1b (Rockall/Hatton):	1482.44	1479.00

Total biomass (TSB) was estimated at 1.48 million tonnes for the area surveyed. This estimate is not comparable with the 2005 estimate of abundance due to the geographical difference in survey area.

SSB of blue whiting in the area surveyed was estimated at 98.5% of the total abundance estimate, this value assumes all fish at 20cm and over are mature and spawning.

Total biomass is summarised per rectangle (1° latitude by 2° longitude) and shown in Table 6. A breakdown of stock maturity by area in numbers and biomass is provided in Table 4.

Stock composition

The blue whiting stock within the surveyed area was found to be dominated by 4 year old fish (year class 2002). This year class represented over 40% of adult blue whiting by weight and numbers within the survey area (Figure 4a). Fish of age group 3 and 5 were found to be less abundant, representing 19% and 20% of numbers respectively, and 16% and 23% of biomass respectively. Younger and older age groups, 1,2,6 and 7 year olds, were less abundant and composed the remainder of the stock. Overall Trawl samples were observed to contain individuals of 1 to 8 years of age (Table 4,5 and 6).

Hydrography

A total of 28 CTD stations were carried out during the survey where vertical profiles for temperature and salinity were measured up to 800 m depth. The stations covered a rectangular area between 55°N and 60°N latitude and 11°25'W and -8°W longitude over and in the vicinity of the Rockall Bank. The CTD data was compiled to produce horizontal temperature and salinity profiles for the survey area at 10, 200, 400 and 600 m depths (Figs. 5a and 5b).

In general temperature and salinity decreased with increasing altitude and depth. Surface temperature (at 10 m depth) dropped from 11°C to 9°C going North, but an inflow of cooler, fresher water from the North moving South over the Rockall Bank was observed. At 10 m depth salinity values ranged between 35.3 and 35.5 as measured at the most Northern and Southern stations respectively. At larger depths the intrusion of fresher cooler water from the North was recognized West of the Rockall Bank, intruding further South with increasing depth. At 600 m depth temperature was decreased by about 1°C, varying between 7.9°C and 9.9°C, and salinity by about 0.1 ranging from 35.2 and 35.4. The range of temperature and salinity values was comparable to the values found last year. At the two shallow stations (< 200 m deep) on top of the Rockall Bank the water was well mixed, all other stations showed mixed surface layers with a depth ranging from 50 m to 550 m. The mixed layer depth was largest North and East of the George Bligh Bank and smallest over the Rockall Bank. The mixed surface layer appeared to be shallower than last year when depths well over 600 m at the deep stations were found.

ACDP (Acoustic Doppler Current Profilers) data was collected over the course of the survey and the results are pending.

Marine Mammal and Seabird counts

A full report of the species and abundance encountered is provided in [Appendix 2](#).

Concluding remarks

Overall the survey was carried out and completed as planned. No changes to the overall cruise track were made. Due to adverse weather conditions the vessel had to dodge (36 hours) and leave the survey track. ER 60 noise problems were a problem in bad weather but were not as troublesome as previous years. As a result of bad weather some hydrographic stations were cancelled.

Area coverage in 2006 was 2125 nmi. More trawl hauls and CTD stations were conducted in the survey area than in 2006.

Results of the survey indicates that the bulk of the spawning stock had completed spawning. This was supported by opportunistic contact with the commercial fleet when encountered, as they reported catch rates and fish abundance had decreased in some areas.

Maturity was assumed for all fish over 20 cm in length. This length was chosen in the absence of up to date maturity at age data for the combined stock and is recognised by ICES (ICES 2005), that the values of maturity at age are too low. This survey found that fish of 19cm were fully mature.

The second most abundant species on the survey were Dealfish. This species was observed in 15 of 17 trawl hauls during the survey as compared to only 5 hauls in 2005. A definitive explanation for this increased abundance is not evident but may be related to the more extensive offshore survey coverage area. The participant research vessels in the survey reported similar findings.

The Bergen Echo Intergration (BEI) system was used in parallel with echoview software on a trial basis. As expected, results were similar however there were problems with the ships hydraulics affecting the BEI. This will be investigated by the ships engineers.

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Crew List:

Basil Murphy	Stephen Lantry
Dinny Sharry	Shane Horan
Damien McCallig	Frank Kenny
Jason White	Michael Doogan
Dave Stewart	Paddy O'Driscoll
Davy Murphy	Thomas Byrne
Pat Codd	Vincent Devitt

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References

- Anon. (Monstad et al), 1982. Report of the International acoustic survey on blue whiting in the Norwegian Sea, July/August 1982. ICES, Doc.CM. 1982/ H.5.
- Anon (2002) Underwater noise of research vessels. Review and recommendations. 2002. ICES No. 209
- Bailey, R. S. 1982. The population biology of blue whiting in the north Atlantic. Adv. Mar. Biol. 19:257-355.
- Foote, K.G., H.P. Knudsen, G. Vestnes, D.N. MacLennan and E.J. Simmonds. 1987. Calibration of acoustic instruments for fish density estimation: a practical guide. ICES Coop. Res. Rep. 144, 57pp.
- Heino, M., Godø, O. R., Søiland, H., Nygaard, J. E., Alvarez, J., de Lange, J., Drivenes, L., Gullaksen, O., Tangen, Ø. and Torkelsen, T. 2003. Blue whiting survey during spring 2003. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 29 April-8 May 2003.
- Heino, M., Søiland, H., Nygaard, J. E., Alvarez, J., de Lange, J., Eriksen, K. B., Kristiansen, J., Meland, E., Tangen, Ø., Oleynik, A., Varne, R. and Wienerroither, R. 2004. Blue whiting survey during spring 2004. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 27 April-4 May 2004.
- ICES PGNAPES Report 2005. Report of the Planning Group on Northeast Atlantic Pelagic Ecosystem Surveys. ICES CM 2005/D:09, Ref. G, ACFM, ACE.
- ICES 2005. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES CM 2005/ACFM:05
- ICES 2003a. Report of the Planning Group on Surveys on the Pelagic Fish in the Norwegian Sea. ICES CM 2003/D:10, Ref. ACFM, ACE.
- ICES 2003b. Report of the Northern Pelagic and Blue Whiting Working Group. ICES CM 2003/ACFM:23.
- Mackey, M., Ó Cadhla, O., Kelly, T.C., Aguilar de Soto, N. & Connolly, N. (2004). Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume I - Seabird distribution, density & abundance. Report on research carried out under the Irish Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6 and 00/13, Porcupine Studies Group project P00/15 and Offshore Support Group (OSG) project 99/38. Cork, CMRC: 95pp.
- Mitsen R.B. 1999. Underwater Noise of Research Vessel: Review and Recommendations. ICES Coop. Res. Rep. 209

Monstad, T., 1986. Report of the Norwegian survey on blue whiting during spring 1986. ICES, Doc. C.M. 1986/h.53

O'Donnell, C., Clarke, M. & Dransfeld, L., Review of Irish Acoustic Survey program, 1989-2004. 2005. Irish Fisheries Investigation Series (In press)

O'Donnell, C., Mullins, E., Monstad, T., Macualay, G., Power, G. and Ullgren, J. 2004 .Blue Whiting Acoustic Survey Cruise Report. Marine Institute, Ireland.

O'Donnell, C., Mullins, E., Power, G., Goddijn, L. and Mackay, M. 2005. Blue whiting Acoustic Survey cruise Report. Marine Institute, Ireland.

O'Donnell, C., Griffin, K., Clarke, M., Lynch, D., Ullgren, J., Goddijn, L., Wall, D., and Mackay, M. (2004). Celtic Sea Herring Acoustic Survey Report, 2004.

O'Donnell, C., Macaulay, G., Roar Haride, N., Johnston, G., Ullgren, J., Shephard, S., Sachetti, F., Grehan, A., Wilson, M. (2005) Orange Roughy Acoustic Survey Porcupine North and West Survey Report, 2005.

Oganin, I., Ratushnyy, S., Astakhov, A. and Guzenko, V. 2004. Blue whiting survey during spring 2004. Working Document to The Northern Pelagic and Blue Whiting Fisheries Working Group, Copenhagen, 27 April-4 May 2004.

Skjoldal, H. R., (Ed). The Norwegian Sea Ecosystem (2004). Tapir academic press.

Toresen, R., Gjøsæter, H. and Barros de, P. 1998. The acoustic method as used in the abundance estimation of capelin (*Mallotus villosus* Müller) and herring (*Clupea harengus* Linné) in the Barents Sea. Fisheries Research, 34: 27–37.

List of participants

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Mick Mackay	CMRC, Ireland	MMO & Seabirds

Table 1. Settings for the Simrad ER 60 echosounder, employed during the survey transects, March 2006.

Echo sounder:	Simrad ER 60
Frequency:	38 kHz
Transducer:	ES 38B- Serial
Absorption Coefficient:	9.6 dB/Km (manual)
Pulse length:	1.024 m/s
Bandwidth:	2.425 kHz
Transmitting Power:	2000 W (Max)
Angle Sensitivity:	21.9 dB
2- way beam angle:	-20.6
Gain:	25.23
S _A Correction:	-0.73
3 dB Beam Width:	
Alongship:	7.5°
Athwartship:	7.5°
Max Range:	1000m

Table 2. Catch composition of trawl hauls. Note: The term “Mesopelagics” is used to group mesopelagic species (vertebrate and invertebrate) and includes all species encountered excluding blue whiting, bottom (demersal) species and mesopelagic piscivores such as Dealfish.

Haul No.	Date	Start Position (Lat & Long)	Stop Position (Lat & Long)	Target Depth (m)	Bottom Depth (m)	Effective Fishing time (min)	Bulk Catch (Kg)	Species	% catch composition
1	23/03/2006	55°02.53 N & 11°50.43 W	55°02.53 N & 11°48.86 W	550-600	>1000	15	37.4	Blue Whiting	13.04
								Mesopelagics	1.78
								Deal fish	82.83
								Black fish	2.35
3	25/03/2006	55°42.34 N & 16°57.43 W	55°42.35 N & 17°00.51 W	400-470	480	30	75.82	Blue Whiting	97.70
								Mesopelagics	1.90
								Grey Gurnard	0.40
5	26/03/2006	55°43.30 N & 11°53.71 W	55°43.31 N & 11°54.47 W	500-550	2600	15	40.45	Blue Whiting	83.71
								Mesopelagics	3.21
								Dealfish	13.08
6	27/03/2006	56°23.98 N & 15°57.56 W	56°23.71 N & 15°54.34 W	470-500	500	36	77.83	Blue Whiting	82.85
								Mesopelagics	08.18
								Dealfish	03.07
								Grey gurnard	05.90
7	28/03/2006	56°36.51 N & 17°57.83 W	56°35.48 N & 17°57.72 W	550-600	1300	20	61.57	Blue Whiting	05.36
								Mesopelagics	02.47
								Dealfish	92.17
8	29/03/2006	57°02.52 N & 15°08.79 W	57°02.49 N & 15°09.54 W	360-460	450-500	10	500	Blue Whiting	99.54
								Mesopelagics	0.02
								Grey Gurnard	0.44
9	30/03/2006	57°40.43 N & 11°25.84 W	57°40.13 N & 11°25.77 W	500-600	2000	10	500	Blue whiting	99.9
								Mesopelagics	0.10
10	31/03/2006	57°42.62 N & 14°56.09 W	57°42.65 N & 14°54.38 W	400-450	450-530	20	35.97	Blue Whiting	90.18
								Mesopelagics	0.92
								Dealfish	08.90
11	02/04/2006	58°45.69 N & 17° 57.64 W	58°44.97 N & 17° 57.82 W	450-500	557	11	500	Blue Whiting	88.55
								Mesopelagics	0.95
								Dealfish	10.50
12	02/04/2006	59°58.17 N & 17°58.17 W	59°54.04 N & 17°58.13 W	450-550	2600	26	300	Blue Whiting	57.72
								Mesopelagics	0.213
								Deal fish	42.06
13	03/04/2006	59°15.02 N & 16°37.30 W	59°16.22 N & 16°37.41 W	500-550	645	18	148.55	Blue Whiting	23.01
								Mesopelagics	0.69
								Dealfish	76.30

Table continued overleaf.....

[illegible]

Length (cm)	Age in years (Year class)								Nos (10 ⁶)	Tns (10 ⁶)	Mean weight (g)
	1 2005	2 2004	3 2003	4 2002	5 2001	6 2000	7 1999	8 1998			
16.5	22	0	0	0	0	0	0	0	22	0.47	21
17	0	0	0	0	0	0	0	0	0	0.00	22
17.5	45	0	0	0	0	0	0	0	45	1.06	24
18	67	0	0	0	0	0	0	0	67	1.68	25
18.5	22	0	0	0	0	0	0	0	22	0.63	28
19	0	67	0	0	0	0	0	0	67	2.26	34
19.5	0	0	0	0	0	0	0	0	0	0.00	36
20	0	45	0	0	0	0	0	0	45	1.75	39
20.5	22	22	0	0	0	0	0	0	45	1.93	43
21	0	157	22	0	0	0	0	0	179	8.42	47
21.5	0	67	0	0	0	0	0	0	67	3.29	49
22	0	134	157	45	0	0	0	0	336	17.13	51
22.5	0	45	90	22	0	0	0	0	157	8.62	55
23	0	45	112	90	0	0	0	0	246	14.28	58
23.5	0	90	112	90	0	0	0	0	291	18.05	62
24	0	45	269	134	0	22	0	0	470	30.33	65
24.5	0	0	246	403	0	0	0	0	649	43.50	67
25	0	45	560	537	90	22	0	0	1254	89.02	71
25.5	0	67	336	896	112	22	0	0	1433	107.47	75
26	0	0	336	896	313	45	0	0	1590	125.58	79
26.5	0	0	179	761	336	67	0	22	1366	111.99	82
27	0	22	358	1052	358	90	0	0	1881	157.98	84
27.5	0	0	157	560	224	45	0	0	985	90.63	92
28	0	0	90	582	425	90	0	0	1187	115.11	97
28.5	0	0	22	403	269	45	22	0	761	83.74	110
29	0	0	67	179	224	90	22	0	582	67.82	117
29.5	0	0	0	112	134	134	0	0	381	45.29	119
30	0	0	22	112	224	112	0	0	470	61.59	131
30.5	0	0	22	90	179	90	0	22	403	54.81	136
31	0	0	22	67	67	45	22	0	224	31.35	140
31.5	0	0	0	90	134	67	22	0	313	46.08	147
32	0	0	0	22	67	90	45	0	224	34.03	152
32.5	0	0	0	0	45	45	45	0	134	21.43	160
33	0	0	22	45	90	0	0	22	179	30.63	171
33.5	0	0	22	22	0	22	0	0	67	11.69	174
34	0	0	0	22	0	22	22	0	67	11.62	173
34.5	0	0	0	0	0	22	0	0	22	4.39	196
36	0	0	0	0	0	0	67	0	67	14.78	220
36.5	0	0	0	0	0	0	0	22	22	5.35	239
40	0	0	0	0	0	0	22	0	22	6.67	298
TSN (10⁶)	179	851	3224	7232	3291	1187	291	90	16344	1482.44	
% Mature	0	100	100	100	100	100	100	100			
TSB 10⁶kg	4.37	43.22	242.45	636.69	342.56	144.7	50.41	18.02	1482.44		
SSB 10⁶kg	1.09	43.22	242.45	636.69	342.56	144.7	50.41	18.02	1478.07		
Mean Weight (g)	24.38	50.80	75.20	88.04	104.08	121.95	173.20	201.25			
Mean Length (cm)	18.1	22.3	22.5	26.7	28.3	29.3	33.2	31.6			

Table 5. Aged stratified estimate of surveyed stock abundance. Blue whiting survey, March 2006.

Table 6 Breakdown of abundance estimate of total survey area by rectangle, including haul allocation. Blue whiting survey 2006

Rectangle	S _a m ² /n.m ²	Area n.mile ²	Trawl haul(s) #	Length (cm)	Density coeff. $1.488 * 10^6 * L^{-2.18}$	Abundance N *10 ⁶	Weight (grams)	Biomass 1000 tns
5612	522.00	1800.00	1+5	26.75	1151.25	1081.72	89.66	96.99
5614	347.00	1770.00	1+5	26.75	1151.25	707.09	89.66	63.40
5616	154.00	843.00	3	26.15	1209.75	157.05	97.72	15.35
5618	99.00	66.30	3	26.15	1209.75	7.94	97.72	0.78
5712	892.00	1800.00	5	27.09	1119.64	1797.70	93.84	168.70
5714	32.50	256.00	5	27.09	1119.64	9.32	93.84	0.87
5716	235.00	1766.00	6+8	24.06	1449.85	601.70	75.57	45.47
5718	78.00	1894.00	6+7	26.61	1163.99	171.96	104.09	17.90
5812	1015.00	1800.00	9	26.89	1137.69	2078.56	94.73	196.90
5814	104.50	1660.00	8	23.05	1592.74	276.29	63.03	17.41
5816	324.00	2190.00	8+10	24.96	1338.82	949.98	78.32	74.40
5818	37.00	2893.00	8+10	24.96	1338.82	143.31	78.32	11.22
5912	129.00	1800.00	9+17	26.34	1190.02	276.32	90.92	25.12
5914	263.00	3600.00	16+17	25.75	1250.25	1183.74	87.39	103.45
5916	164.00	3600.00	14 + 16	26.50	1175.18	693.83	94.39	65.49
5918	147.50	3521.00	11+13	27.24	1106.33	574.57	106.14	60.99
6012	168.00	1800.00	17	26.34	1190.02	359.86	90.92	32.72
6014	410.00	3600.00	16 + 17	25.75	1250.25	1845.37	87.39	161.27
6016	360.00	3600.00	14+15+16	26.49	1175.20	1523.06	94.21	143.48
6018	243.00	3227.00	12+13	26.61	1164.14	912.87	97.43	88.94
6112	112.00	315.00	12	26.52	1172.58	41.37	95.32	3.94
6114	409.50	900.00	15	26.49	1175.26	433.14	93.68	40.58
6116	413.00	900.00	17	26.34	1190.02	442.33	90.92	40.22
6118	78.00	812.00	17	26.34	1190.02	75.37	90.92	6.85
Total						16344.46		1482.44

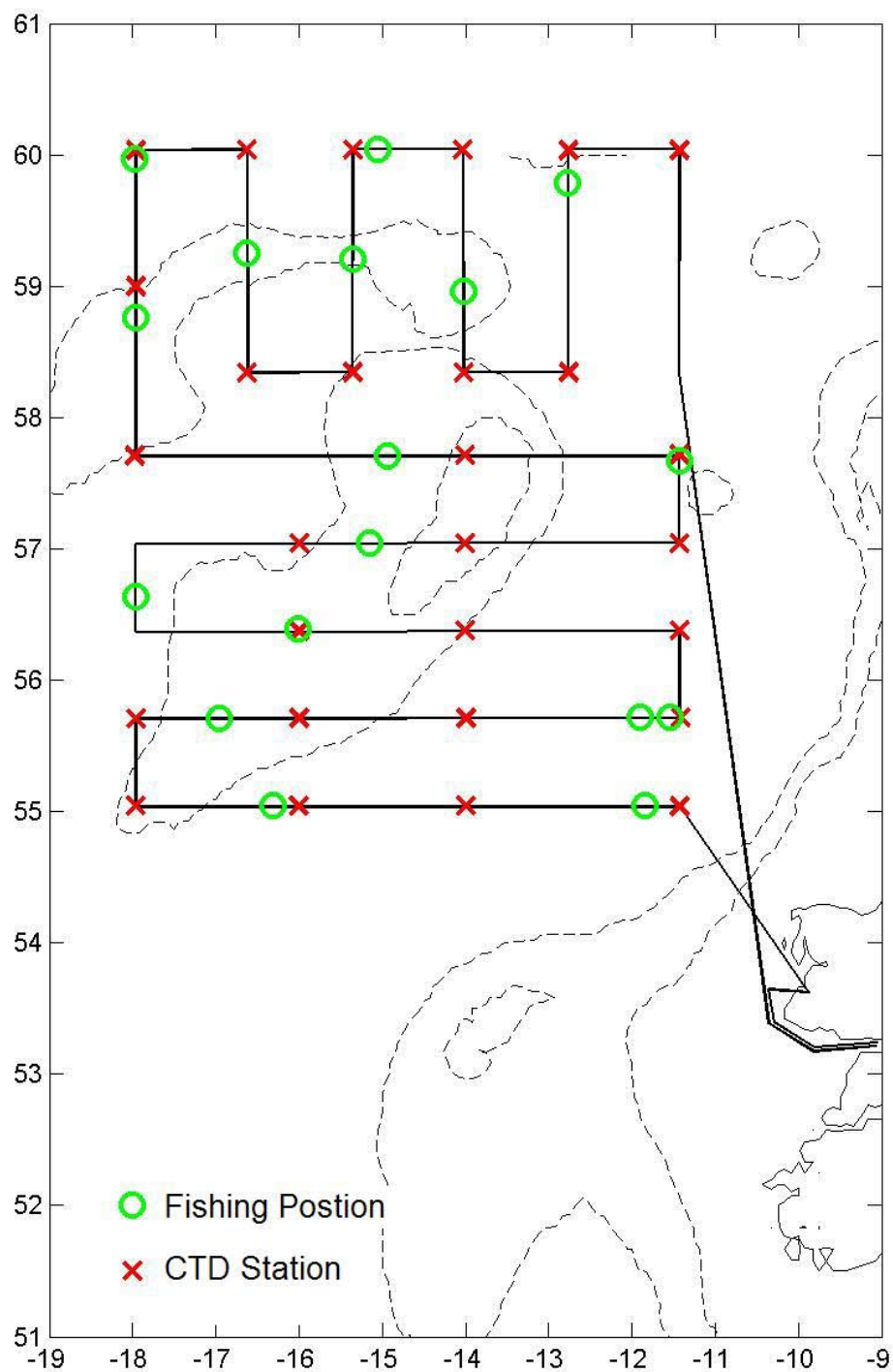


Figure 1 Cruise track for the Irish component of the International Blue Whiting Acoustic Survey March – April 2006 with Trawl and CTD locations.

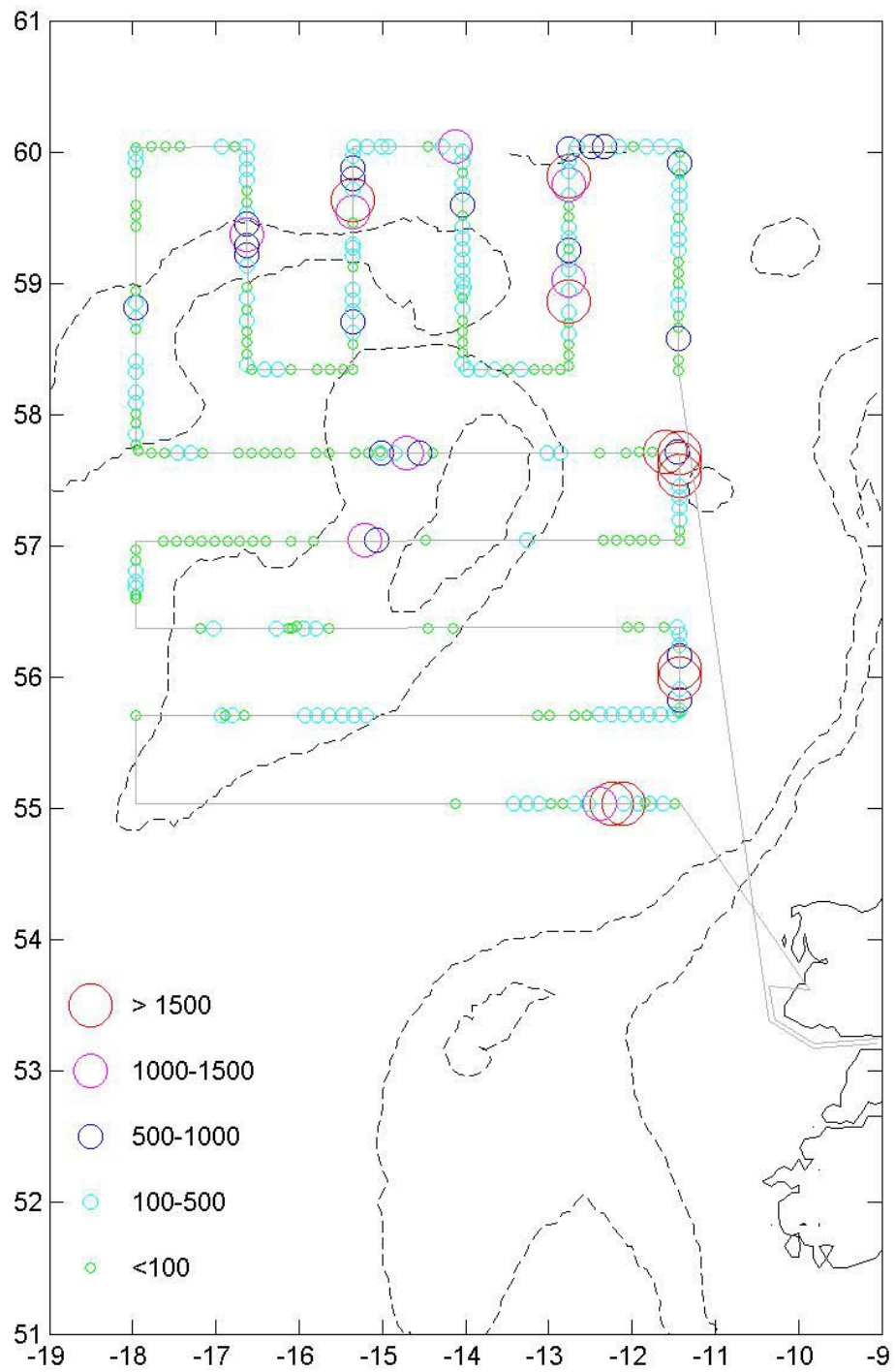


Figure 2 NASC circle plot of blue whiting occurrence, circle size relative to NASC value. Blue whiting acoustic survey, March – April 2006.

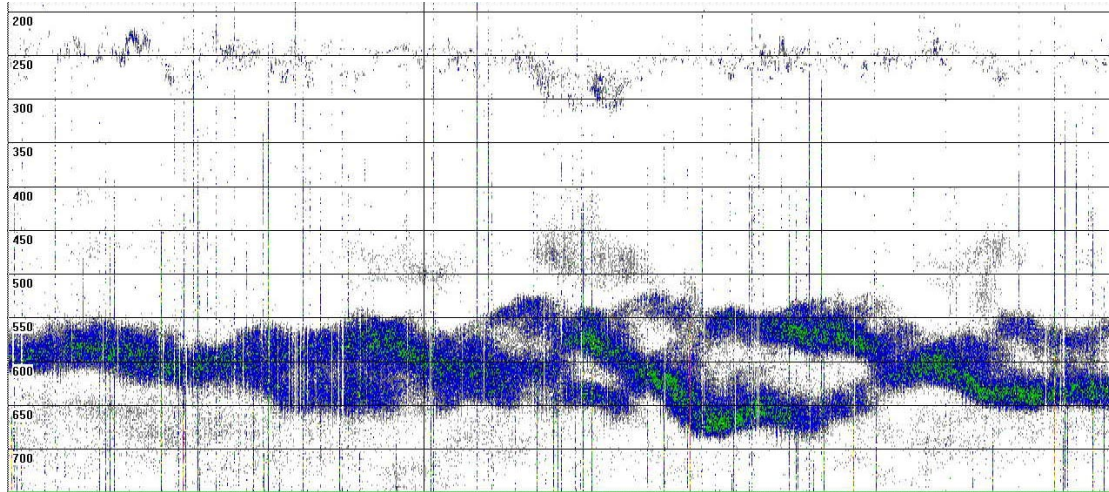


Figure 3a . Large Blue whiting mark in deepwater south of the Bill Bailey Bank.

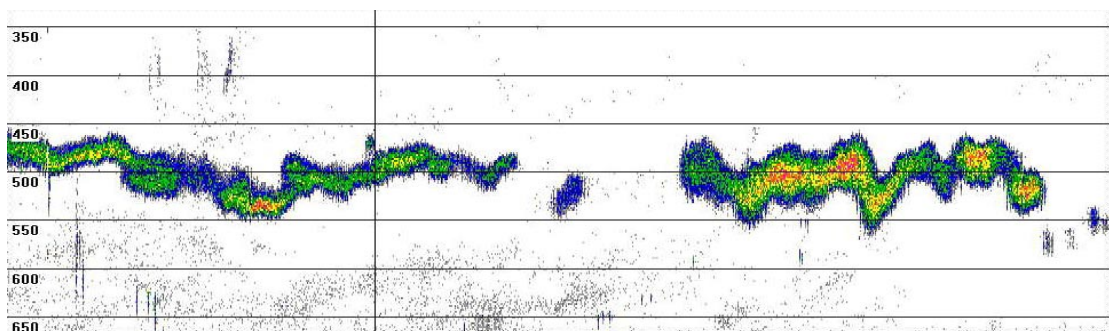


Figure 3b. Dense marks of Blue whiting west of Anton Dhorn seamount in the Rockall Trough.

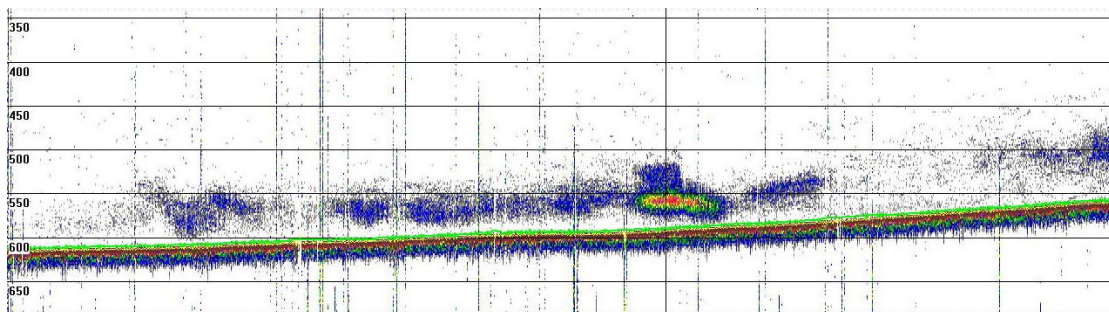


Figure 3c. Marks of Blue whiting on Hatton Bank.

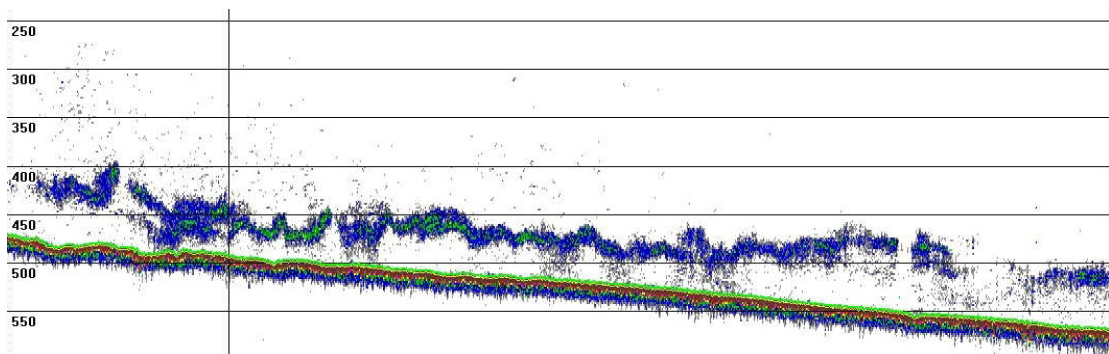


Figure 3d. Blue Whiting on the west side of Rockall Bank.

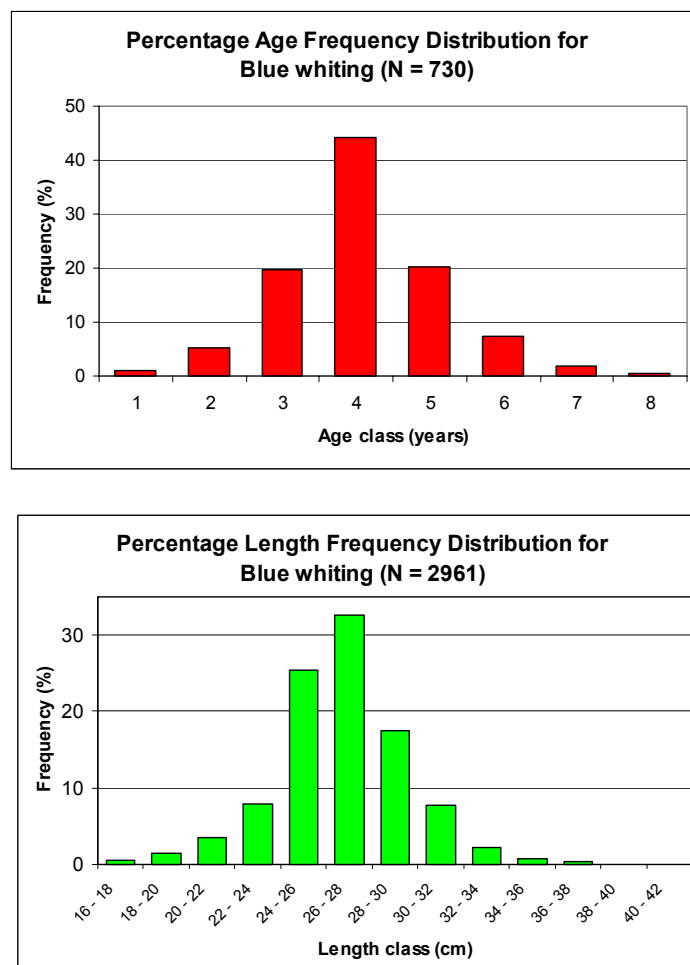


Figure 4a. Age and length frequency distributions for blue whiting sampled in the survey area during Spring 2006.

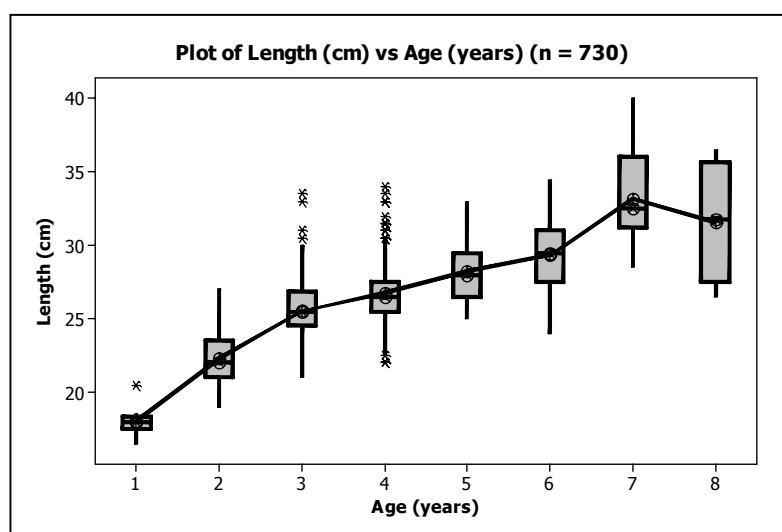


Figure 4b. Mean length at age for blue whiting sampled in the survey area during Spring 2006. The 50% quartiles (Boxes) and 75% quartiles (lines) for observed data is plotted. Data outside the 75% quartile range is included as outliers.

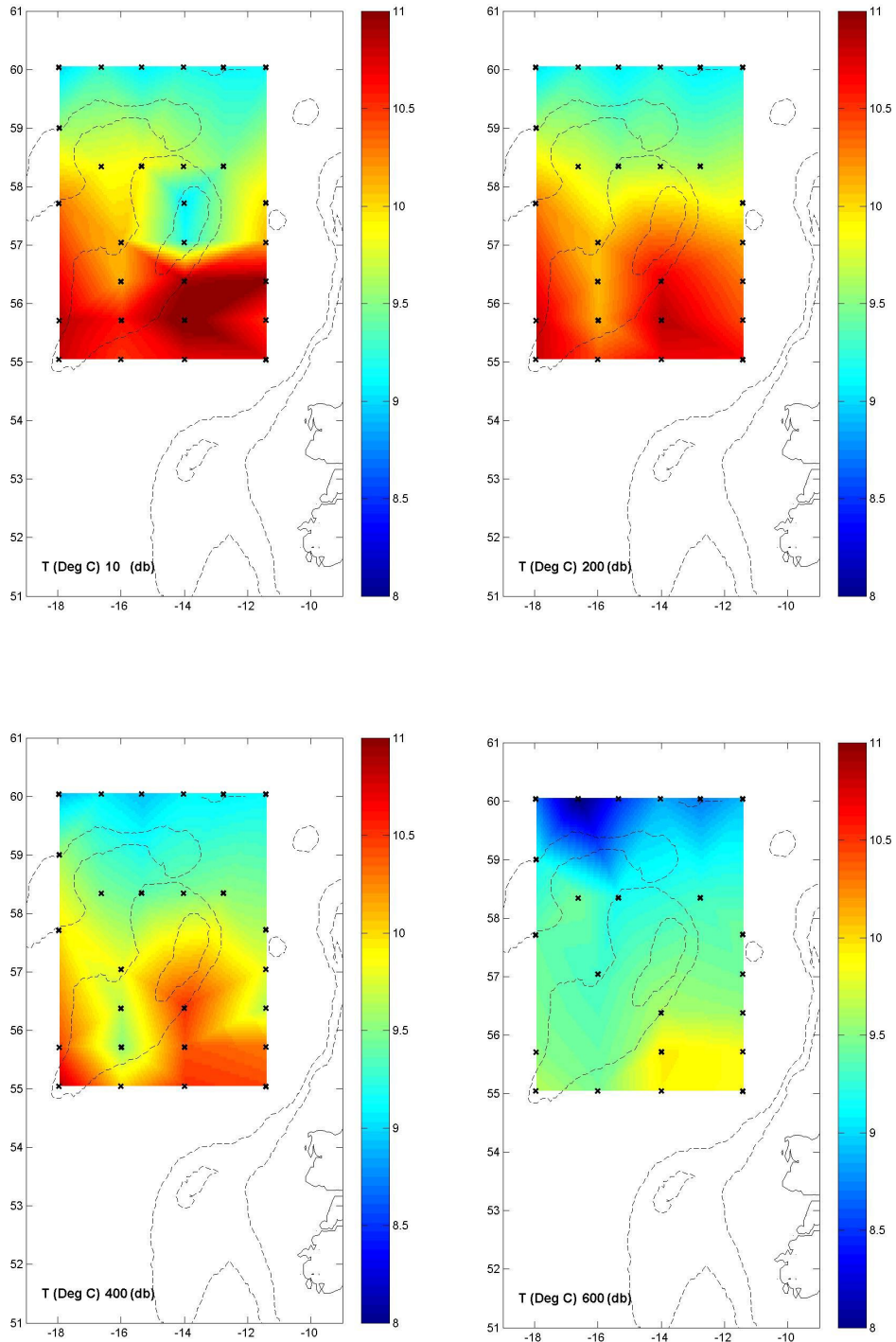


Figure 5a Horizontal temperature profiles at surface to 600m compiled from CTD casts, March-April 2006.

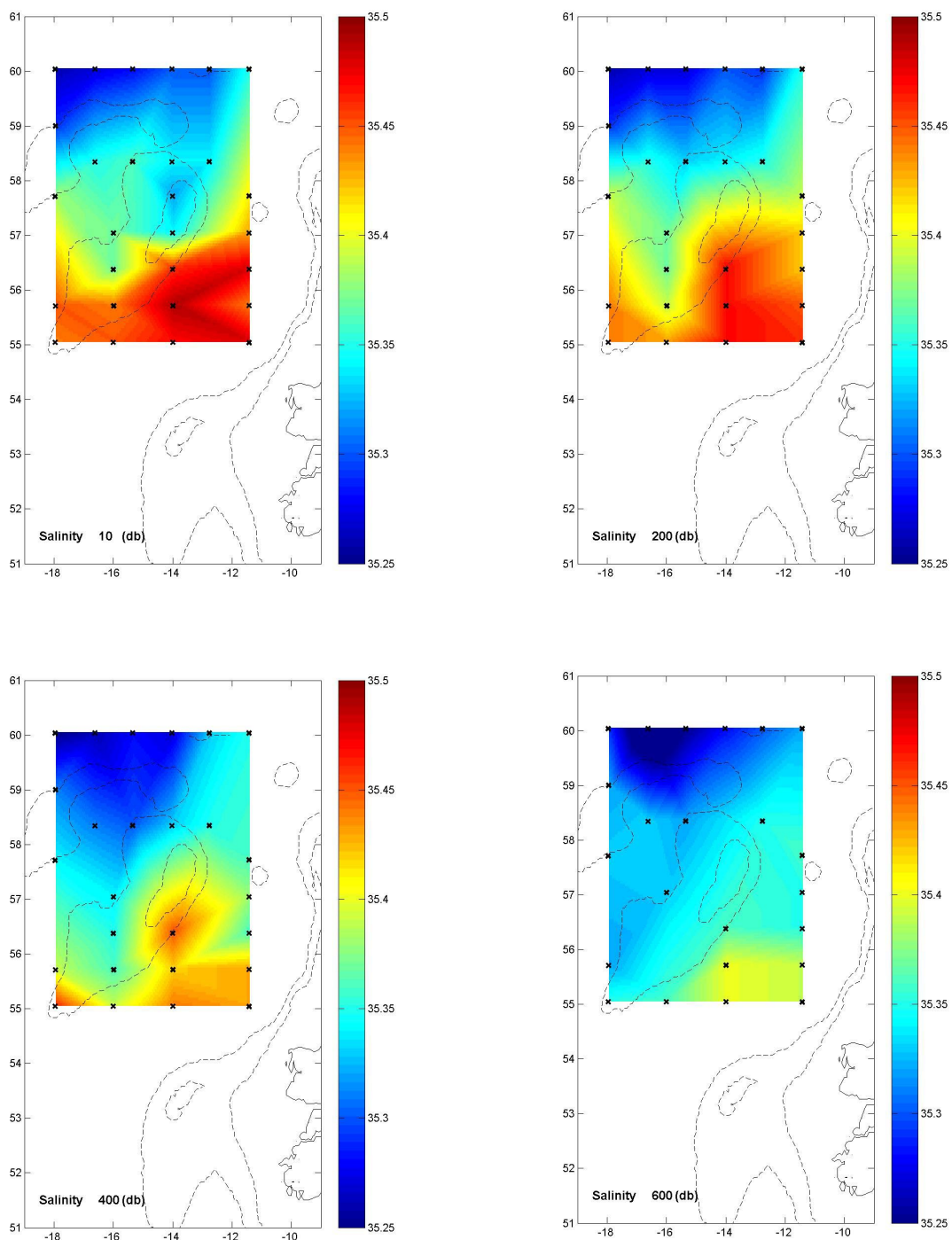
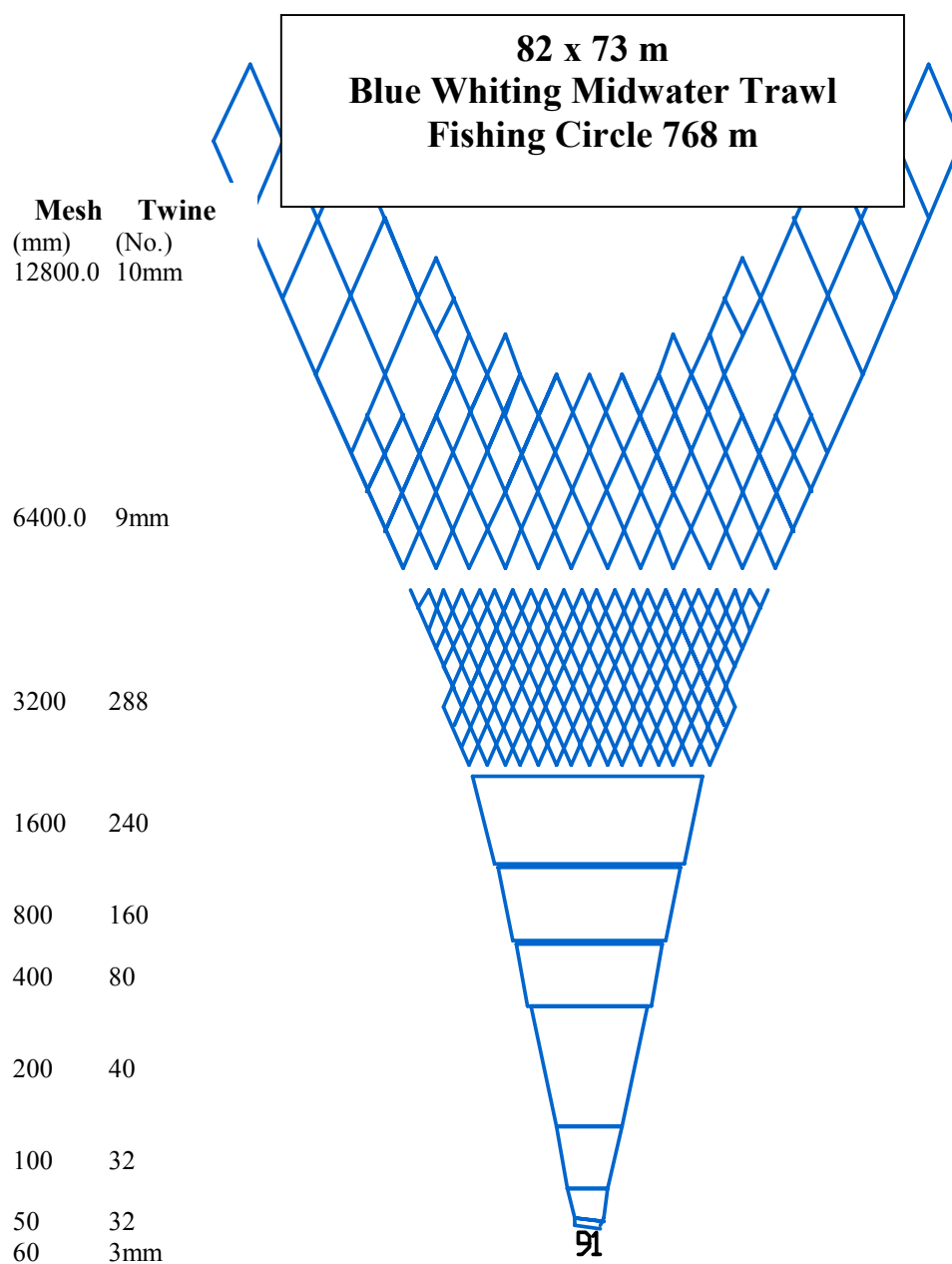


Figure 5b Salinity profiles at surface to 600m compiled from CTD casts, March-April 2006



Clump weights: 1000 Kg per side

Trawl doors: Polyice pelagic 6m² (weight in air 750Kg)

Bridle length: 148m (80fm)

Figure 6 Pelagic midwater trawl employed during the Blue whiting Acoustic Survey, March 2006.

Appendix 1.

Inter-vessel coordination

Bulletin 1

International Blue whiting Acoustic Survey 2006

RV 'Celtic Explorer'

March 24th

Greetings fellow Blue whiting scientists!

Just a short email to update everyone on the progress of the Irish contingent, with regards to the 2006 Acoustic Survey for Blue whiting.

After a memorable St. Patrick's weekend in Galway by crew and scientists alike, the RV 'Celtic Explorer' departed Galway Docks on Wednesday 22nd March 8:30 am. Arrived at Killary Harbour, Co. Mayo at 17:00pm and undertook a calibration of the ER60 at 38 kHz. Departed Killary Harbour at 21:00pm and arrived at the beginning of acoustic transect no. 1 at position 55° 2.39 N and 11° 25.43 W at 10:30 am on Thursday 23rd March having successfully carried out a test of the pelagic fishing gear beforehand. At present we are progressing along this westerly transect at position 55° 02.5N and 16° 17.16W and have encountered some light patches of post spawning blue whiting at 500-600m depth.

We would greatly appreciate if each Vessel could forward on to us a short summary (5-10 lines, text only!) of progress to date, current position, fish concentrations observed and approximate locations of respective fishing fleets if encountered. This information will allow us to compile and circulate a brief bulletin to each participant Research Vessel. This bulletin may be updated every few days, serving to keep all Research Vessels and Institutes informed of international progress. We are also running the annual 'Who can catch the most blue whiting' competition again this year! Prizes include Guinness and Power's Whiskey, and will be presented at the post cruise meeting in Torshavn!

Bulletin 2

International Blue whiting Acoustic Survey 2006
Celtic Explorer 28th March.

Greetings all,

Just to update everybody on our progress to date along our planned survey track. We are now at position 5638N and 1757W cruising along a northerly transect. Weather conditions at present are fresh but manageable after some very poor conditions encountered over the past 18 hours. We have covered approximately 30% of planned survey transects and are working our way from south to north. Surveyed transects have to date identified fish concentrations in two main areas;

- (a) Scattered concentrations along the shelf and upper slopes of the south of Rockall bank with post spawning concentrations of blue whiting found 20-100m off the bottom along or below the 500m depth contour. These fish were nearly all stage 7 of maturity with a high proportion in feeding condition. Four year-old fish dominated sample hauls with some younger and older age groups also present.
- (b) More concentrated concentrations along the mid Rockall Trough area. Fish in this area were found to be mainly post spawning and were located at 500-600m depths forming a distinct 'snake' like distribution. Again, four-year-old fish dominated sample hauls.

While surveying the latter region we encountered several vessels of the Dutch fleet at position 5550N and 1150W on 26/03/2006. We established contact with one of the skippers and understood that fishing success was poor in this area at that time with several hours fishing yielding approximately 60-70 tonnes blue whiting. These vessels were actively looking for better fish concentrations at the time and informed us that they had been in contact with RV Tridens that had been working in the general area previously.

Furthermore, several large (presumably Russian) factory ships were seen cruising over the Rockall Trough probably in transit from fishing grounds west of Rockall Bank, although this has yet to be confirmed by contact with RV Atlantniro. Lastly, a record number of dealfish (15) were taken in one haul at position 5502N and 1150W for a haul of 20 min duration! Perhaps a sign of local concentration in abundance or global warming!

That concludes the main progress and observation to date from RV Celtic Explorer. As of yet we have not been able to contact both RV Tridens and RV F Nansen but have been in touch with RV G O Sars. The Norwegian vessel is presently en route to Stornoway for crew change and a 24-hour rest. The locals have been forewarned of this annual invasion and have locked up all their women and shut all pubs in preparation! Hopefully weather conditions will have improved by the time they resume on Survey.

Wishing you all pleasant weather conditions and a safe and enjoyable survey.

Bulletin 3

International Blue whiting Acoustic Survey 2006
Celtic Explorer 02nd April.

Greetings colleagues,

Here is the latest update on the progress of RV Celtic Explorer.

We are currently at position 58° 53N & 17° 58 W, and having covered the west section of our planned survey area we are now beginning to cruise along a north/south transect network, working our way East to longitude 11° 20. As you will be aware, weather conditions over the past 48 hours have been poor. This has reduced our progress accordingly. However, we have had some encouraging signs of fish in the following areas,

1. In slope areas to the west of the Rockall Bank, north of latitude 57° 00 N. Post-spawning 3 and 4 year-old fish dominated these concentrations.
2. In areas immediately to the west of the Anton Dohrn Seamount. Four year-old post-spawning fish dominated samples taken from in this area. Norwegian and Dutch Vessels were observed fishing in this area on 30th March.
3. Along the Hatton Bank. Heavier concentrations were recorded in this area with samples again composed of 3 and 4 year-old post-spawning fish.

This updates our survey progress at present. We plan to conduct an inter-calibration with our Norwegian friends sometime during the coming week as they have resumed survey work after a mid-cruise crew change. Both the RV Atlantniro and RV Tridens have concluded acoustic work and left the survey area. We wish our colleagues a safe return journey. We would also like to welcome the Faeroese Research vessel RV Magnus Heinason to the survey area as of 31st march and hope the weather will shortly improve for all research vessels remaining!

Bulletin 4

International Blue whiting Acoustic Survey 2006
RV Celtic Explorer 06th April.

Greetings to all,

Here is the latest news from the Irish contingent.

We are currently in situ at position 59° 18 N & 12° 59 W, and are waiting for the current bad weather to pass over before resumption of survey track. We have approximately 250 NM of planned transect remaining (encompassing the NE section of our survey area) and upon completion we plan to depart the survey area sometime on Saturday pm! :-)

The following are the main updates since our last bulletin:

4. Some encouraging recordings of blue whiting in areas to the north of Hatton Bank. 4 and 5 year-old spawning and post-spawning fish dominated trawl samples in this area.
5. Heavier concentrations of fish were recorded along the ridge, joining the Hatton Bank and the George Bligh Bank. Concentrations were heaviest along the 600-800 m contours with trawl samples having similar age structure and maturity profiles to those taken to the NW of this area.
6. Several vessels of the Russian Deepwater Fleet were observed conducting fishing operations in the vicinity of position 59° 32 N and 15° 21 W on 04/04/06. Only moderate registrations of blue whiting were recorded in this immediate area, however our survey track passed several miles from the main fleet activity.
7. Good recordings were registered over the George Bligh Bank along the 500-600m contours. Trawl samples taken in this area were dominated by 4 year-old post-spawning blue whiting.
8. Faeroes and Russian fishing vessels were observed working in areas immediately to the west of position 59° 45 N and 15° 10 W on 05/04/06. Again, RV Explorer registered moderate recordings in this immediate area.
9. A combination of poor weather conditions, locally unfavourable fish registrations and survey vessel timing has resulted in a postponement of our planned Inter-calibration with our Norwegian friends on RV G O Sars.
10. Lastly, time at sea has been taking its toll on some of our guest scientists onboard. Our Danish biologist has completely run out of cigarettes and has been forced to smoke shredded cartoon magazine pages in desperation! While our Norwegian Acoustician's addiction to coffee has exhausted vessel supplies and he is now reluctantly forced to drink a somewhat near alternative, Swedish Tea!!!

This concludes our survey progress at present. We will keep all survey vessels informed of our progress over the coming week. As you are all aware there are now only three research vessels remaining in the survey area. We have not yet established contact with the RV Magnus Heinason, but hope all is well with our Faeroese friends. We also hope that weather conditions will improve for all!

Appendix 2

Seabird & Cetacean Observation Summary

Observer: Mick Mackey (Coastal & Marine Resources Centre)

As part of the Marine Institute's (Fisheries Scientific Services Division) blue whiting survey of the continental slope and the Rockall and Hatton Banks, I was invited to conduct opportunistic surveys of the offshore and coastal cetacean and seabird populations. The current survey is an extension of the Irish Cetaceans and Seabirds at Sea study, undertaken by the Coastal & Marine Resources Centre (CMRC) on behalf of the Rockall Studies Group and Porcupine Studies Group of the Petroleum Infrastructure Programme - a programme set up by Ireland's Department of the Marine and Natural Resources in 1997. The main aims of the research are:

- (1) to establish reliable baseline information on the distribution and abundance of seabirds and cetaceans off western Ireland throughout the year;
- (2) to identify critical habitats for these species; and
- (3) to assess any behavioural responses of seabirds and cetaceans to the ship's acoustic & fishing operations; and
- (4) to provide independent scientific information essential for conservation and management purposes.

The following report summarizes the seabird and cetacean distribution and behaviour recorded during the current survey.

Methods:

The primary visual survey method used aboard vessels of opportunity was that outlined by Tasker *et al.* (1984) and Webb & Durinck (1992). Originally designed by the Joint Nature Conservation Committee (JNCC) as a standard method for counting seabirds at sea, the survey technique has been expanded to include cetacean sighting records. The method generally consists of a strip-transect survey (Buckland *et al.*, 2001) conducted by a single scientific observer who records survey effort, environmental conditions (e.g. glare, water depth, wind strength, swell height), positional data, and sightings of the various species encountered to one side of the vessel's trackline.

The survey method requires that the vessel was travelling on a straight course, at a constant speed of 5-15 knots, and in sea conditions no greater than those of Beaufort Force 6. The observers was situated on the vessel's monkey-island at a platform height of ~15m. The observer conducted visual scans with the naked eye in a 90° bow-to-beam sector forward of the ship, concentrating on a 300m-wide strip, from which seabird density estimates may be calculated. Water-resistant binoculars (*LEICA* 10x42) were used to confirm features such as species identification, group size and behaviour.

General binocular scans for cetaceans were also conducted in the 180° area ahead of the ship when seabird encounter rates were low. The binocular scans allowed for early detection of cetaceans, in addition to clearer assessments of behavioural responses to the ship's acoustic operations. General 360° cetacean scans were carried out when climatic conditions were unsuitable for surveying, or when the ship was stationary during fishing operations. All data collected during this survey will contribute to the Irish Cetacean and Seabirds at Sea study's database maintained by the CMRC, and the central European cetacean and seabird databases maintained by the JNCC in Aberdeen.

Study Area:

The primary study area during the cruise concentrated on the deep waters throughout the Rockall Trough from west of the Porcupine Bank, around the Anton Dohrn Seamount and south of the Rosemary Bank, and along the western and southwestern slope of the Rockall Bank (Figure 1). Moderate levels of effort were also achieved along the continental slope northwest of the Porcupine Bank, west of Achill Island and west of St Kilda.

Results:

Survey Effort

Full surveys of cetacean and seabird populations were only conducted during nine of the 19 days of the cruise (22nd March – 9th April). The average working period for each day was generally restricted to 7.00am and 8.00pm GMT, although ship downtime, high wind conditions and severe sun glare severely limited available survey time further. Approximately 275km² of full survey effort was achieved during the three-week study (Figure 1). This relatively low level of survey effort was due to the poor climatic conditions experienced throughout the survey.

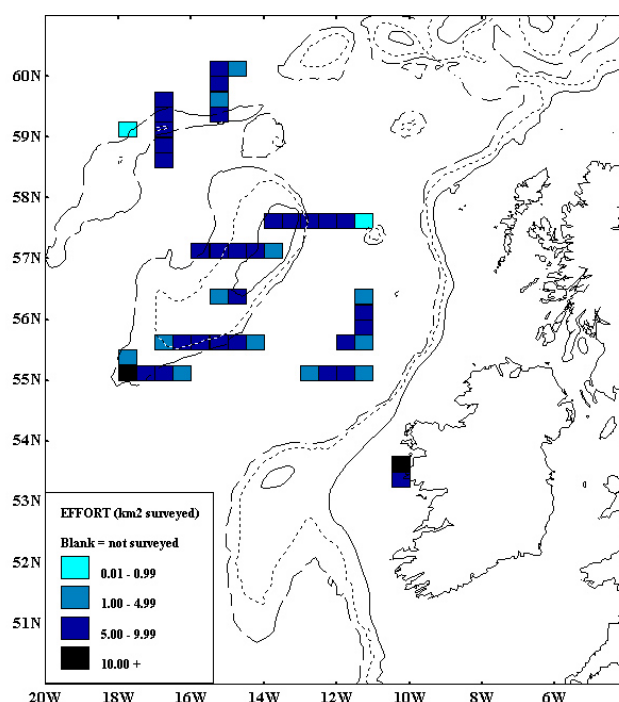


Figure 1. Full survey effort achieved during the blue whiting survey, 22nd March – 9th April 2006.

Cetaceans

Only one cetacean species, long-finned pilot whale (*Globicephala melas*) (Figure 2), was observed during five separate encounters during the three-week survey.

A total of 53 pilot whales (Plate 1) were observed during five separate encounters throughout the survey. This represents a relatively low encounter rate when compared to recent offshore surveys. The overall low encounter rate was due in part to the poor weather-related sightability, which plagued the survey throughout. Group sizes of this squid-eating species ranged from three to 30 animals. The two largest groups were observed over the deep-water region of the Rockall Trough (between 2650m & 2850m). The other three sightings were all recorded within a four-hour period over or north of the northeast slopes of the Hatton Bank (between 750m & 1700m) (Figure 2). The consistent sighting of long-finned pilot whales during offshore surveys indicates that the waters west of Ireland are of great year-round importance to this gregarious and inquisitive species.

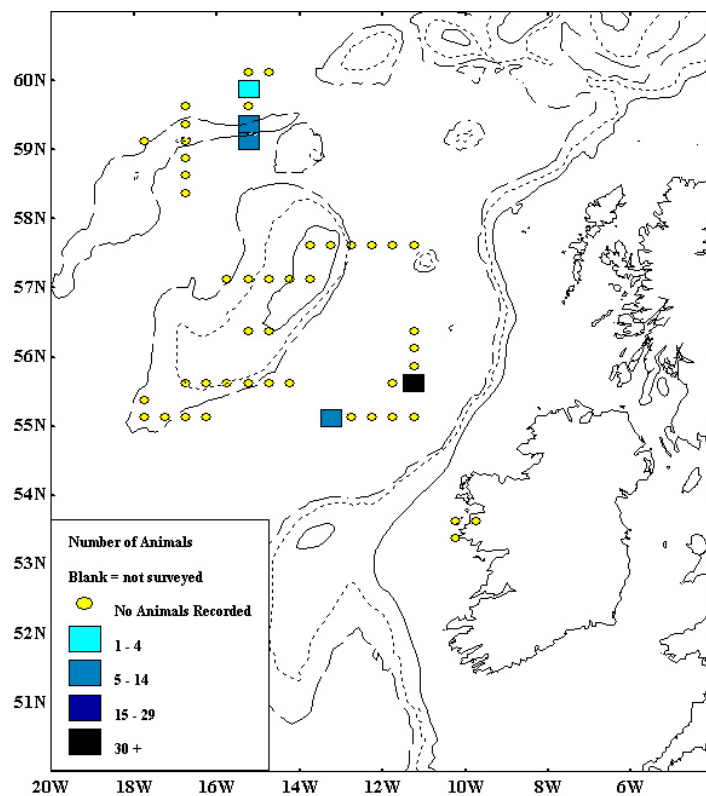


Figure 2. Pilot whale sighting locations, 22nd March – 9th April 2006.



Plate 1. Long-finned pilot whales were the only cetacean species encountered throughout the survey.

Seabirds

Fourteen seabird species and one coastal bird species were recorded during the 19-day survey (Table 1). By far the most frequently encountered seabird species was the northern fulmar, which was constantly observed in close association with the survey vessel and surrounding fishing vessels. Black-legged kittiwakes and lesser black-backed gulls were also regularly observed trailing the survey vessel awaiting the discarded offerings. These two gull species were also frequently observed during independent feeding episodes where the main target species was the pipefish (Plate 2).

Adult northern gannets were regularly observed in low concentrations over the deep-water region, west of the Rockall Bank. The largest group of northern gannets was observed associated with a fleet of blue whiting fishing vessels situated approximately 130 nautical miles southwest of St Kilda, the world's largest gannetry. All the gannets were observed in direct association with the fishing fleet or flying northeast towards St Kilda.

Occasional sightings of Manx shearwaters, common guillemots were recorded throughout the survey period. They were most frequently observed over the shallow waters closely associated with Rockall. The sporadic offshore sightings of adult Atlantic puffins is also noteworthy. Other seabird species to be recorded in low concentrations included razorbill, black-headed gull, herring gull and great black-backed gull.

The great skua was consistently recorded throughout the survey period. Absolute numbers of this aggressive species is difficult to assess due to their loose association with the survey vessel. The smaller pomarine and arctic skuas were only observed once, marking the start of their return migration to northern feeding/breeding grounds. Long-tailed skuas were not observed during the survey.

The only coastal bird species to be observed offshore during the current survey was the oystercatcher.



Plate 2. An adult lesser black-backed gull displaying a freshly caught pipefish.

Table 1. Seabird and coastal bird species encountered during the blue whiting survey, 22nd March - 9th April 2006.

Common Name	Latin Name
Northern Fulmar	<i>Fulmarus glacialis</i>
Manx Shearwater	<i>Puffinus puffinus</i>
Northern Gannet	<i>Morus bassanus</i>
Oystercatcher	<i>Haematopus ostralegus</i>
Pomarine Skua	<i>Stercorarius pomarinus</i>
Arctic Skua	<i>Stercorarius parasiticus</i>
Great Skua	<i>Stercorarius skua</i>
Black-headed Gull	<i>Larus ridibundus</i>
Lesser Black-backed Gull	<i>Larus fuscus</i>
Herring Gull	<i>Larus argentatus</i>
Great Blacked-backed Gull	<i>Larus marinus</i>
Black-legged Kittiwake	<i>Rissa tridactyla</i>
Common Guillemot	<i>Uria aalge</i>
Razorbill	<i>Alca torda</i>
Atlantic Puffin	<i>Fratercula arctica</i>

References:

- Buckland, S.T., Anderson, D.R., Burnham, K.P., Laake, J.L., Borchers, D.L. & Thomas, (2001). *Introduction to Distance Sampling. Estimating abundance of biological populations*. Oxford University Press. Oxford. 432pp.
- Tasker, M.L., Jones, P.H., Dixon, T. & Blake, B.F. (1984). Counting seabirds at sea from ships: a review of methods employed and a suggestion for a standardized approach. *Auk* 101: 567-577.
- Webb, A. & Durinck, J. (1992). Counting birds from ship. In J. Komdeur, J. Bertelsen, & G. Cracknell. (eds.). *Manual for aeroplane and ship surveys of waterfowl and seabirds*. IWRB Special Publication No. 19. Slimbridge. p 24-37.

Appendix 3

Blue Whiting survey 2006 Celtic Explorer
Daily Log:

22/3/06

Departed Galway @ 8:30 bound for killary. Arrive at killary at 16:30 vessel anchored and settled by 17:10, started calibration @17:20. Done CTD drop .

Temp at 12m: 7.8°C and 34.2 salinity.

38 khz calibrated suceesfully, difficulty with 200khz due to tide and darkness so stopped. Departed killary at 21:50. Going to do practice trawl in the morning.

23/3/06

Practice shot at 06:30, wind SE 3-4, slight swell. Realise that we have no depth sensor for net! Have door spread will have to charge up wing sensors again. Made up graph from last years haul data of net depth against warp length! Start of track with CTD at 09:50 then steaming west. Marking blue-green marks about 500m depth logged for a while then shot (Haul 1), small catch blue- whiting, meso and 15 Deal-fish!

24/3/06

Wind E 3-5, slight swell steaming west, marks high up in water about 150-200m decide to trawl in case of juvenile blue whiting! Haul2 mostly pearlsides and pipefish meshed in the brailer. Steam west no marks.

25/3/06

Transect 3 steaming east, light wind, slight swell, came across blue 'dust' rising 50m off bottom carried it for 3-4 miles so decide to shoot (Haul 3). Blue whiting length range from 20-36.5cm mostly spents. Blue dust along bank a lot of them tight to seabed, not best ground for trawling! Steaming east no concentrations should get some again further east into the Rockall Trough.

26/3/06

Started marking blue whiting for about 30 miles to the end of transect 3, had a tow (Haul4), light scatter when towing very hard to see fish with headline transducer. Hauled, few blue whiting and a dealfish, so decide to shoot again only steam a bit more to the west for denser mark. Shot again (Haul5) better result could see more fish entering net, got a sample, all spents. Continued north onto transect 4 still marking blue whiting blue/green colour not dense, passed 7 dutch factory ships to the west of us at 55°50N and 11°50W. MFV Johanna Maria called us up for chat wondering about better concentrations and location of Norwegian fleet. They had 7-8 hr tows for 60 tonnes! Gave GO Sars a call regarding intercalibration, going to leave it till after their port call in Stornoway on the 31st.

27/3/06

Continuing west along transect 5, should get some fish on edge of Rockall bank. Small bits of fish on the eastern edge of the bank but too tight on bottom and steep gradient so not ideal for trawling. Over bank fairly good layer of fish rising 20-30m off seabed, carried it for about 30 miles, weather deteriorating but decide to shoot. Shot but hauled back due to no footrope signal, hauled in and found it twisted so shot again, better picture towed for 30 mins and got sample. Large Russian factory ship steamed west of us heading south probably searching! Weather getting worse took few heavy rolls so decide to dodge morning.

28/3/06

Started back on track about 6:30, slight swell, wind N-NW5-6 some meso marks high up about 200m. Started to mark blue whiting at 550m on transect 6 heading north, carried marks for about 6 miles, very 'watery' mark! decide to have a shot. Not a lot of fish entering net, very scattered. Towed for 45 mins got some blue whiting and 26 Dealfish (Haul 7), weather getting very fresh from the NW so not helping matters. Heavy pitching causing interference on the EK60 doing 3-4knots! Had to cancel CTD at the end of transect 6 due to weather.

29/3/06

Wind NW 5-6 and decreasing more comfort steaming east on transect 7 back towards Rockall bank. Started to mark blue whiting at 500m carried them for 11 miles up to 400m. Had a shot (Haul 8), mark 30-100m height from seabed, good picture on headline transducer showing fish going in above footrope. Towed for 8 mins and yielded 500kg. Smaller run of fish to other hauls. Continued steaming east over bank, 1 scottish whitefish trawler towing west at 200m contour. Some blue whiting on the eastern side of the bank but sitting tight to bank and very steep gradient not ideal for trawl, steaming east into Rockall trough.

30/3/06

Steaming east in Rockall Trough on transect 7, after CTD station heading north on transect 8 started to mark some blue whiting, scattered at first but got better towards north of transect. Some good density marks, several Norwegian and Dutch trawlers working just west of the transect all towing south. Had shot (Haul 9), towed for 6 mins on mark for 500 kg, best registrations of fish so far. Continued west along transect 9 back onto Rockall Bank, some registrations on east-side of bank but too steep to trawl. Started to mark blue whiting before midnight just off bottom about 30-50m band of fish.

31/3/06

Marked band of fish for about 20 miles, had a shot (haul 10), bigger fish in sample to previous hauls on the west side of Rockall. Continued on west weather deteriorating rapidly NE 8-9 forecasted. Abandoned CTD#17 due to weather and dodged at 17° for 8 hours, wind cyclonic big seas. Wind shifted to the east so continued to 18°W, managed to do CTD and decided to dodge again till morning.

1/4/06

Re-started track at 08:00, steaming north on transect 10, wind NE 6-7, still swell doing 3-4 knots with weather, gapping on EK60 on some blue whiting marks but think best to keep steaming north at slow speed. Marking some blue whiting along 18° line but not very dense just blue scatter! Weather to get better in a couple of days time.

2/4/06

Wind decreased a good deal, marking blue whiting on top of the Hatton Bank, good registrations some with good yellow/red colour carried mark for 4 miles, had a shot (haul 11), good showing of fish above footrope from headline transducer. Catch of about 500kg, blue whiting and dealfish, continued north on transect. Continued steaming north on transect no registrations weather freshening all the time causing vessel to slow down a lot to 3-4knots even slower! Started to mark blue whiting near end of transect, fairly good registrations 450m-550m with some density, had a shot (haul 12), thought it would be important as we are the furthest RV to the NW of the survey area. Haul of about 300kg of Blue whiting and Dealfish! Hoping weather will ease for transect 11 heading east.

3/4/06

Weather much improved, wind N 1-3, steamed east to CTD station along 60°N then south along transect 12 marking blue whiting for about 25 miles in deep to top of ridge. Had a shot (haul 13), blue whiting and dealfish continue south to bottom of transect only light scatter marks. After CTD#22 steam east.

4/4/06

Steaming north on transect 14 started to mark blue whiting up to ridge so decided to have a shot and trawl back south away from ridge (haul 14). Passed few Russian ships to the east of transect on the north side of ridge. Weather starting to freshen from west after CTD#24 steaming east along transect 15 marking several miles of blue whiting scatter not dense. Took another trawl (haul 15) for blue whiting towing west along transect again. Reached CTD#25 before midnight.

5/4/06

Steaming south along transect 16, weather freshening from west. Passed several Faroese and Russian trawlers west of transect at 59.48N and 14.02W. Marked one shoal of blue whiting in area of fleet but main bulk of fish to the west of transect amongst trawlers! Continued marking blue whiting, blue scatter up to top of George Bligh Bank, had a tow (haul 16), mix of juvenile and adult fish. Continued south to end of transect to CTD#26, weather eased slightly but storm forecasted! Steamed east on transect 17 to CTD#27.

6/4/06

Weather starting to deteriorate rapidly, moderate amounts of blue whiting whilst steaming north on transect 18 but a lot of interference on EK60 due to heavy rolling of vessel will soon have to dodge! Started to dodge at 08:15 wind NW 9-10, heavy seas.

7/4/06

Finished dodging at 06:00 and restarted track again steaming N on transect 18. Wind NW 6-7, slight sea. Started to mark blue whiting fairly dense mark carried it for 7 miles, decide to have a shot (haul 17). Russian trawler steaming west whilst hauling. Continued N to end of transect to CTD#28 weather much improved!

8/4/06

Steamed east along transect 19 marking some blue whiting to end of transect at CTD#29. Steamed south along transect 20 weather getting fresh again scattered marks of blue whiting, wind N-NW 8-9 big sea building too rough to shoot if come across any fish. Continued to end of last transect no CTD due to weather finished transect at 10:16. Steaming back to Galway survey complete.