Survey Report: MESH 05_01

For:
Marine Institute of Ireland

R.V. *Celtic Voyager*

16th to 26th September 2005

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Marine Institute Party Chief

Summary report

1. Introduction

1. 1 Preamble

Survey Mesh 05_01 was the first leg of 2005 on the Marine Institute (MI) Research Vessel the *Celtic Voyager*, for the Mapping European Se abed Habitat (MESH) project and took place between the 16th and 26th of September 2005. The survey was designed to concentrate mapping effort at 13 locations, previously selected by the Marine Institute, in conjunctions with the consortium partners, DARD NI and the BGS.

This summary report gives an overview of the survey operations only.

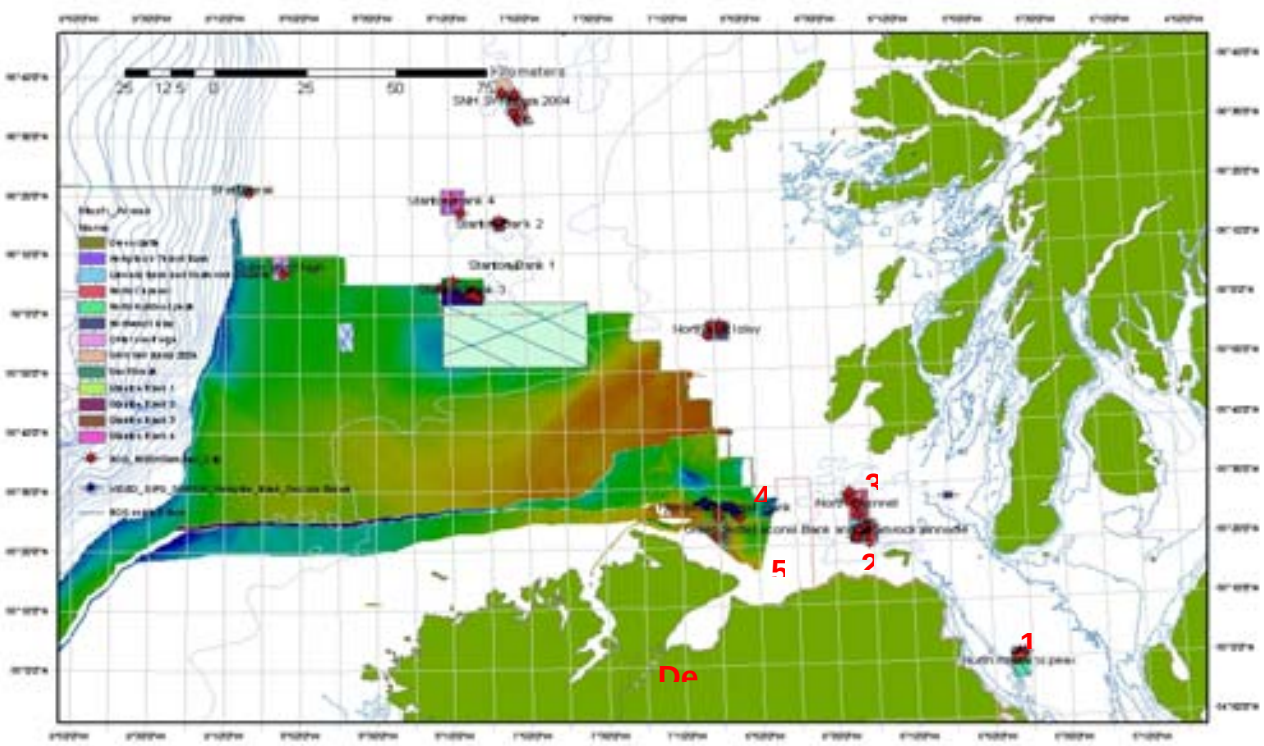

Figure 1-1: **Overview of all MESH sites**

1.2 Scope of Work & survey objectives

The principal objective of the survey was to provide or improve the geological and ecological knowledge of several sites using different techniques, like multibeam swath bathymetry (MBES), single beam echo sounder (SBES), pinger sub-bottom profiler, side scan sonar (SSS) systems, and ECHOPlus acoustic ground discrimination system (AGDS), video camera and sea floor substratum samples. All data were stored digitally on either tape or DVD/CD media, in pre-specified formats and samples preserved in 10% buffered formalin. The configuration of the R.V. *Celtic Voyager* was considered a suitable survey platform.

1.3 Survey areas

1.3.1 North Maidens Peak

The four sparker profiles, acquired during the BGS RRS *Charles Darwin* cruise over the North Maidens Peak area show well-layered country rock, presumed to be Permo-Trias sandstones and siltstones dipping at about 3° to the south with evidence for normal faulting. The seabed frequently shows a step-like topography with rises up to 12m in height, reflecting differential erosion of the outcropping sedimentary rock. Through these rocks an intrusion rises 80m above the surrounding seafloor. The flanks show angles in excess of 30°. The top is predominantly flat, tilted to the south. Pinnacles of 10 - 20 m height rise up from a lower level on the southern flank.

North Maidens Peak was surveyed from the 17th to the 18th of September. The area was surveyed using MBES, SBES, ECHOPlus and Pinger and then 7 sediment locations were sampled. Twenty-one primary lines were surveyed using MBES, SBES, ECHOPlus and pinger. Additional cross lines and infill lines were also surveyed. From analysis of the backscatter data and sub-bottom profiler records, a total of seven grab sample stations were selected. At every station four samples were planned; 3 biological and 1 geological. The results are shown below in Table 1.1

Table 1.1 Summary of the grab samples at North Maidens Peak

Station	Sample No's	Description	Location
2	05,06,07,08	Coarse Sand containing gravel, shells	Southern flank of intrusion
3	01,02,03,04	Hard sedimentary rock with cobbles and shells	SE side of survey area
4	09,10,11,12	Hard bedrock, some gravel and shells	Top of intrusion
5	13,14,15,16	Shelly Sand	NW side of survey area
6	17	Muddy, shelly Sand (only one sample due to currents)	North of intrusion
7	18,19,20,21	Shell fragments only	NE flank of intrusion

There is little evidence of any sediment cover of the bedrock. The most likely area is a hollow within the intrusion on the north side where the seabed appears smooth and horizontal over a distance of at least 150 m. This swept topography fits with basal current predictions by POLPRED of 1 - 1.25 m/s (2 – 2.5 knots). There may be small sediment banks, <3 m height, more than 2 kilometres south east of the intrusion. There is no evidence of sediment backed against the intrusion.

During multibeam acquisition of Line 0018, very noisy data were observed in the north part of the area without any obvious explanation. After 8 hours, an infilling line (L0023) was acquired to fill the gaps previously made by the noisy data, but again, very noisy data were observed in the exact same location. It was decided to take a grab to check what kind of sediment was

generating this effect and very peculiar well-sorted shelly sediment was recovered (grab No.19-20-21).

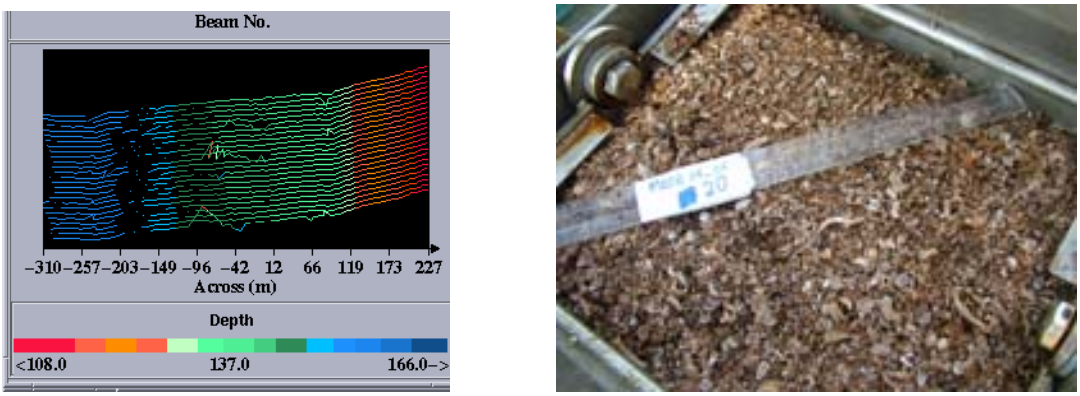

Figure 1-2: the lack of good multibeam data on the portside could be associated with this kind of sediment

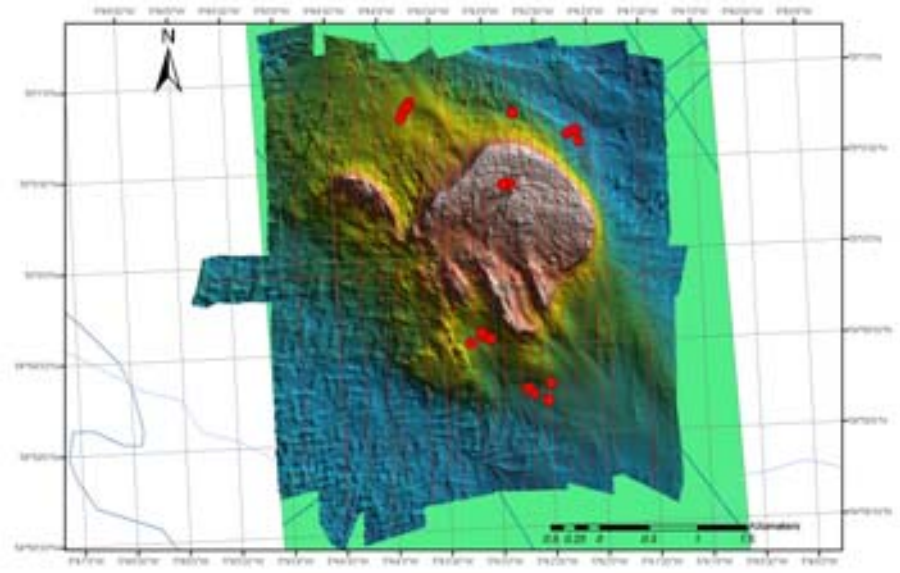

Figure 1-3: Survey area and sampling sites covered in North Maidens Peak.

1.3.2 Laconia Bank

During the RRS. *Charles Darwin* survey, ten profile lines (sparker and boomer) were acquired within the North Channel / Laconia Bank area. The data show well-layered country rock, presumed to be Permo-Trias sandstones and siltstones gently dipping with normal faulting. The dip of reflectors and the frequency of anticlines and synclines increase to the south and east. Where the top of the bedrock is buried it often shows a step-like topography, suggestive of differential erosion of the sedimentary rock. In addition there are at least two intrusions of acoustically opaque rocks at Laconia Bank and one at Shamrock Bank. These intrusions form steep cliffs up to 60° and 100m high. In the northwest corner, on Middle Bank, the exposed bedrock, acoustically opaque, appears to have two type topographies. An outer smooth surface

with bedrock close to and only occasionally breaching the seabed and a hummocky one at the limits of the survey with trough to crests heights up to 30m.

Laconia Bank was surveyed from the 18th to the 19th of September. The area was surveyed using MBES, SBES, ECHOPlus and Pinger and then 6 sediment locations were sampled, at locations selected from the backscatter data and sub-bottom profiler records. At every station four samples were planned; 3 biological and 1 geological. (Table 1.2).

In total, 13 primary lines (lines 0027 to 0039) and 3 infilling lines (lines 0041-0043) were surveyed, with east-west orientation. Two cross lines were collected in a north-south direction.

No video camera lines were acquired.

Table 1.2: Sediment samples at the Laconia Bank site

Station	Sample No's	Description	Location
1	30,31,32,33	Muddy Sand with cobbles and shells	South of Laconia Bank
2	46,47	Hard seabed with occasional cobble	SE flank of Laconia Bank
3	48,49,50,51	Shelly, gravely Sand	East of Laconia Bank
4	25	Shelly, gravely Sand (Failed repeat deployments)	NW of Laconia Bank
5	22,23,24	Shelly, gravely Sand	NW of Laconia Bank
6	26,27,28,29	Veneer of gravel on muddy Sand	SW of Laconia Bank

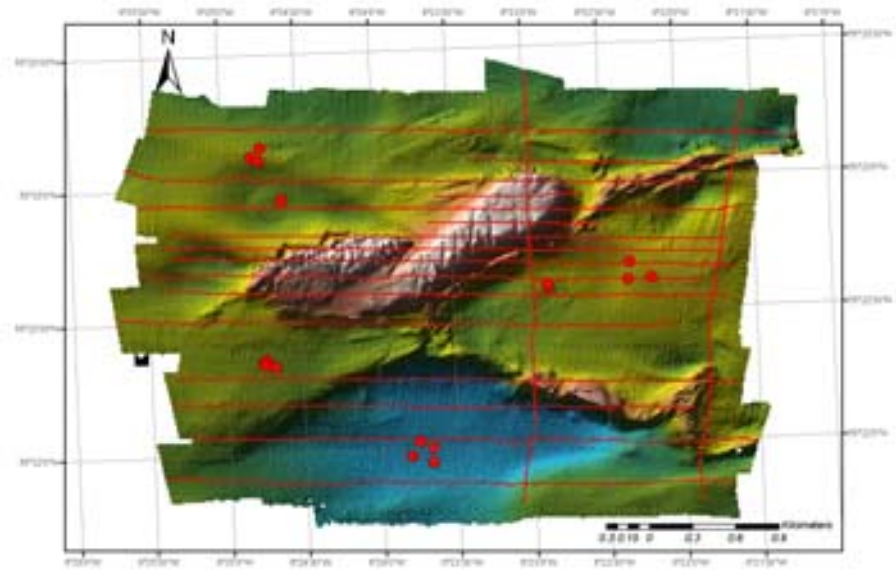

Figure 1-4. Survey area sampling location covered in Laconia Bank.

1.3.3 North Channel

This area was surveyed from the 19th to the 20th of September. The area was surveyed using MBES, SBES, Echo plus, Pinger and Side Scan Sonar (SSS) with an average speed of 2.5-4.5 knots. SSS data were acquired at a range scale of 200m on both channels. Considering the North West corner of the survey area presented quick change in depth and it was decided to do not acquire SSS to avoid any risk of contact with the seabed. This corner was later surveyed with MBES, SBES and ECHOPlus.

In total, 14 primary lines (lines 0045 to 0058), 3 infilling lines (lines 0060-0062) were surveyed. One cross lines was collected in a north-south direction. In accordance with the survey plan, sediment samples were taken on 3 site locations. Two additional samples have been taken on different sites for geological analysis (Table 3.1).

No video camera lines were acquired because the area was too deep. One drop attempt was carried out on the shallowest part but the camera couldn't reach the seabed (85m depth).

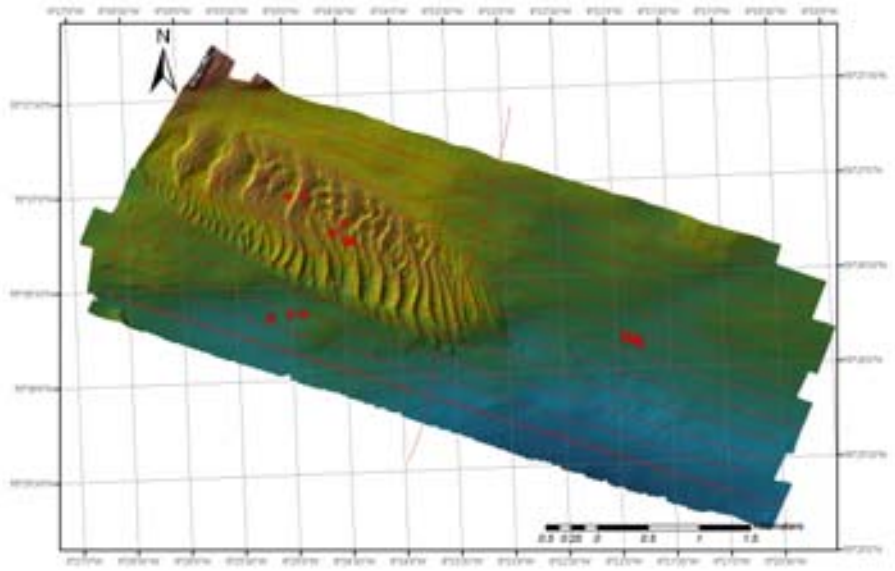

Figure 1-5. Survey area and sampling locations covered in North Channel

Table 3.1 Sediment samples from the North Channel site

Station	Sample No's	Description	Location
1	38,39,40,41	Shelly fine Sand	Centre of sand wave field
2	42,43,44,45	Muddy, gravely Sand	South of sand wave field
3	34,35,36,37	Shelly, gravely Sand	East of sand wave field
4	52,53	Fine to medium Sand	Centre of sand wave field

1.3.4 Hempton Bank

This area was surveyed from the 20th to the 22nd of September. The area was surveyed using MBES, SBES, ECHOPlus, Pinger and SSS. In total 19 primary lines (lines 0063 to 0081) were surveyed. SSS data were recorded at a 200m-swathe range at an average speed of 4-5 knots, depending on direction and tide.

This feature comprises both a major sand bank and a series of large and smaller sand waves spalling off the bank. The bank has a horizontal base and reaches 24m in vertical thickness. Sand waves are present on the top of the bank and occupy a zone of about 8km. There are four well-defined 20m in height and many small ones. Although predominantly asymmetrical in aspect, the large sand waves in the centre of the bank appear symmetrical. The waves at the eastern end of the bank and beyond face northwest. Internal reflectors can be seen in some sand waves and they tend to parallel the steeper face of the wave. At the western end of the bank a thin sequence of westerly dipping fine layering abutting the sand bank.

The base of the bank is characterised by slightly uneven topography, particularly noted under the eastern and north east of the bank. The unconformity has a strong acoustic signature and is considered to be zone of winnowing of outcropping glacial material, possibly morainic in origin considering the few internal reflectors seen below and their irregular shape. Beneath most of the sand bank and to the west a series of gently westerly dipping reflectors are observed. These appear to overlie an extension of the irregular morainic (?) material. A similar sequence of dipping reflectors is seen in the northeast corner dipping to the north. Bedrock varies from 60 to 120ms below seabed and shows internal reflectors dipping to the north. In a few places there is evidence that these reflectors influence the geometry of the bedrock unconformity.

Sample sites were selected from the backscatter data and sub-bottom profiler records, and from the sediment classes found by Ivor Marsh (PhD Student, work in progress). A total of fifteen grab sample stations were chosen (Table 1.4). In accordance with the A total of 15 grabs were collected. No sediment was collected in two locations (see Figure 1.7, black boxes) after 3 attempts.

Table 1.4 Samples from the Hempton Bank

Station	Sample No's	Description	Location
A,B,C,D	66,65,64,63	Shelly Sand	Traverse across several sand waves
1	56	Sandy Gravel	SW of sand waves
3	57	Gravely Sand	SSW of sand waves
5	58	Gravely Sand	SSE of sand waves
6	59	Gravely Sand	SE of sand waves
7	67	Shelly sand	Crest of sand wave
8	54	Shelly gravely Sand	'Nose' of sandbank
9	55	Shelly sand	WNW of sand waves
10	68	Shelly, gravely Sand	Trough of sand wave
11	61,62	Shelly, gravely Sand	NE of sand waves

12	60	Shelly, gravely Sand	ENE of sand waves

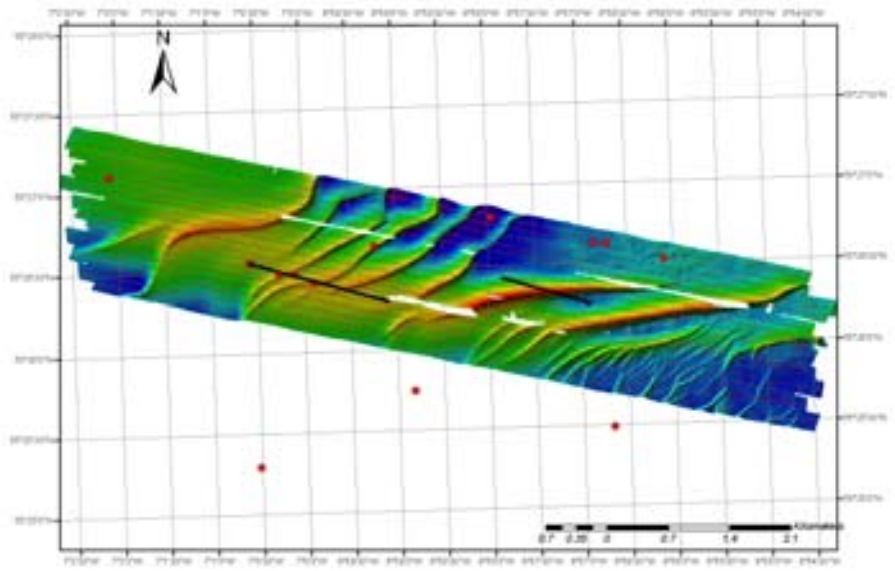

Figure 1-6. Tracks location and surveyed area on Hempton bank

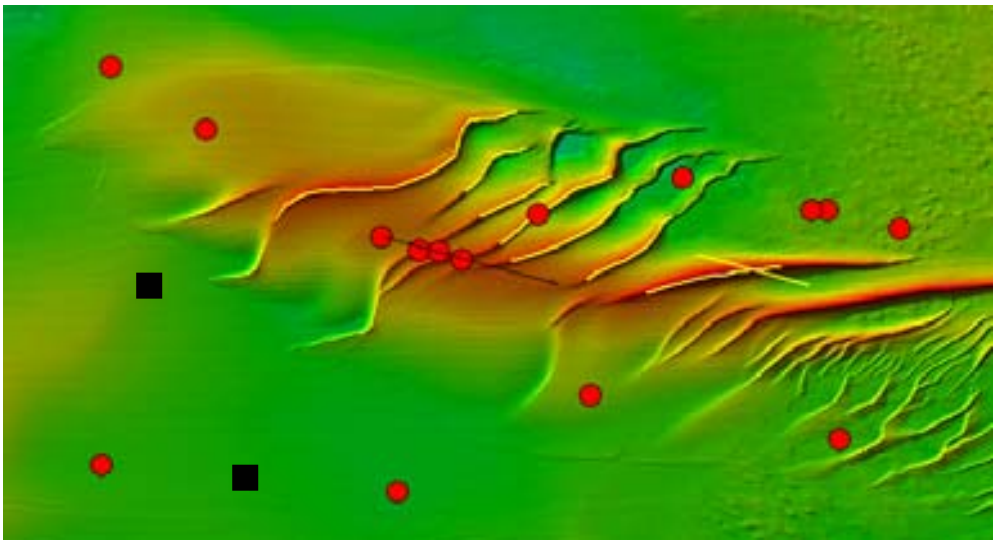

Figure 1-7. Grab location on Hempton bank

Two video transects were acquired on this site (video 1 and 2); one as planned and one additional video transects across one of the highest sand wave (see Figure 1-8).

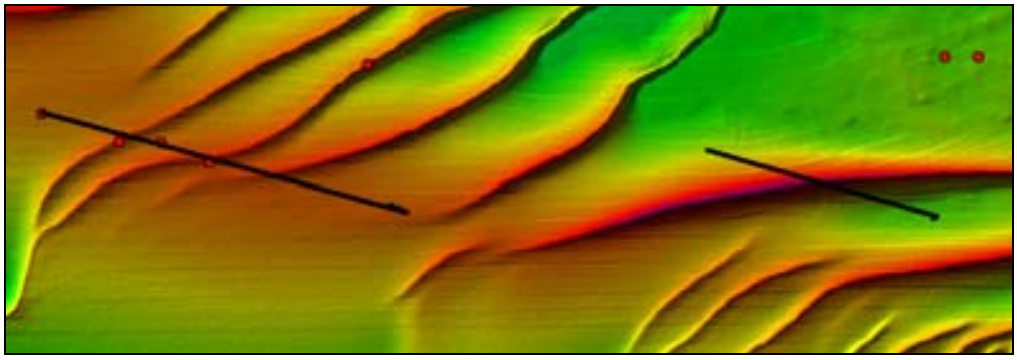

Figure 1-8. Video transects on Hempton bank

A quick comparison between sand wave crest position in July 2004 and September 2005 was done (see Figure 1-9). A general shift ranging from 0 up to 40 m E-SE direction can be observed.

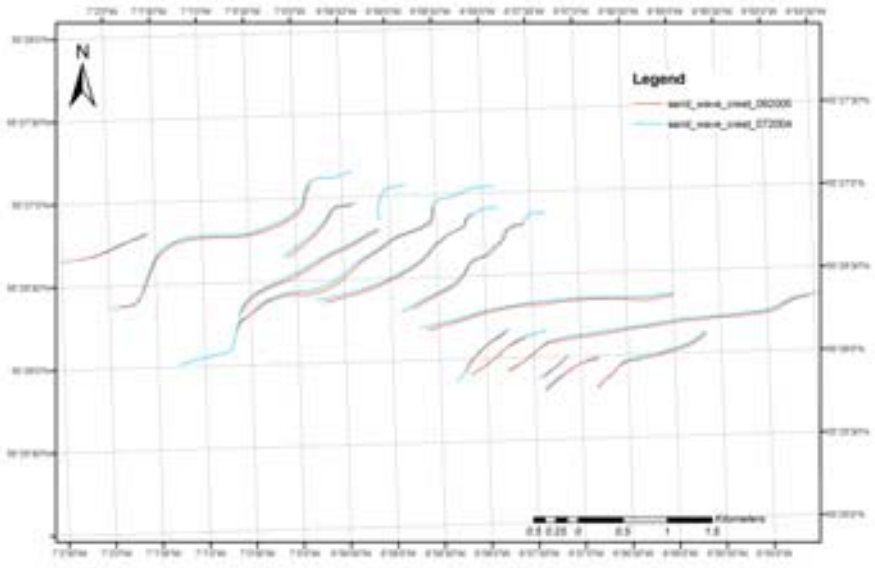

Figure 1-9. Comparison of sand waves crest position in two consecutives years.

1.3.5 Greencastle

This area was surveyed from the 21st to the 22nd of September. In accordance with the survey plan, a total of 9 grabs (N69-77) and 3 video traverses (video n 3,4,5) were successfully collected on specified locations (see Figure 1-10). About 500 m for each video traverse (20 min) were acquired.

Table 1.5 Greencastle sample stations

Station	Sample No's	Description	Location
1	72,73,74	Sand and cobbles	NW corner
3	69,70,71	Gravely Sand	NE corner
Site 3	75,76,77	Muddy, gravely Sand	Southern area

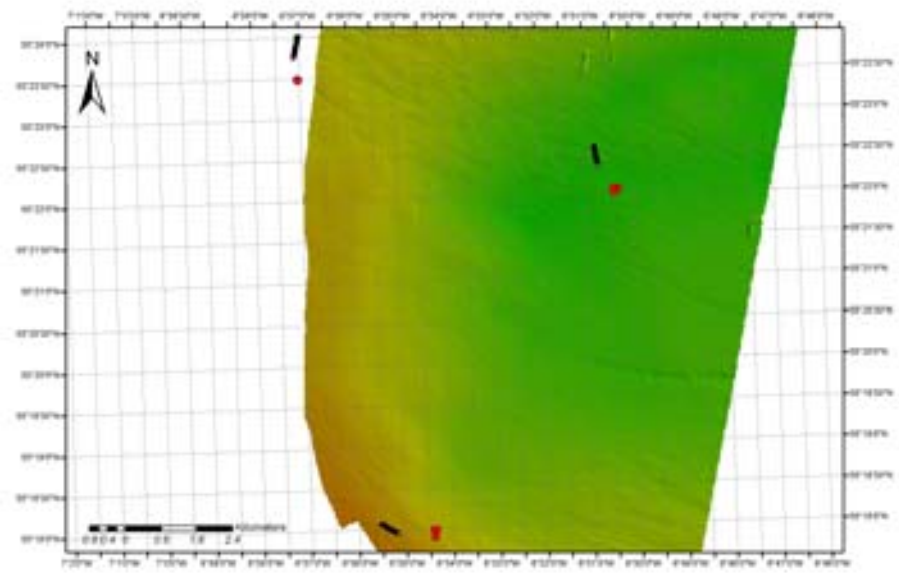

Figure 1-10. Grab and video location on Greencastle

2. General operations

The mobilisation of the R.V. *Celtic Voyager* was completed in Howth on the afternoon of Friday September 16th, 2005. During the previous weeks operations, the vessel was fully operative so only regular check of all equipment was needed. Only the pinger acquisition system needed installation on Friday 16th. Due to Lloyd inspections during the mobilisation day, MTDS decided to postpone the departure to the 17th in the morning. A single beam bar check was required before departure; it was performed the 17th at about 11:00 with high tide

During the installation of the video camera, a problem with the 300 m cable was found. All the video system was working using the dummy cable, but when the 300m cable was installed, there was not communication with the camera. Damage in one of the cables that goes to the light was found and 2 broken connectors were found on the video cable. An attempt to fix the cable was done by the engineer on board but without success. The cable was replaced with the shorter one (240m).

All systems were fully installed and operational (Table 2-1) by the morning of September 17th, when the vessel left Howth arbour.

Table 2-1. R.V. *Celtic Voyager* operational payload

System	Data Sets
Fugro VBS Positioning & Seapath 200	Permits GPS framework positioning and injects time, date and position data to all peripherals and towed sensors.
Simrad EM1002S multibeam echo sounder	100% coverage giving bathymetry and backscatter images that are processed, *via* the CARIS environment, into charts at various scales with digital equivalents.
EA400 dual frequency single beam echo sounder	Depth data integrated with the swath data. Data retained for archiving and future research.
AML 12plus velocity metre	Velocity profiles for echo sounder calibration. Data retained in digital format for archiving and future research.
Kongsberg Video Camera and lights	Video recording for habitat mapping ground truthing
AGDS – ECHOPlus	Allow an acoustic seabed classification
Geoacoustics Side Scan Sonar and transceiver unit	High-resolution backscatter imaging of the seabed
SES 5000 Pinger transceiver with 2x2 transducer array & CODA topside acquisition and interpretation suites	High-resolution geophysical profiles with paper record and digital recording.

2.1 Geodetic parameters and projections for project area

Geodetic parameters employed on the survey are provided in Table 2-2.

Table 2-2. Geodetic parameters

Datum	ETRS 89
Spheroid	WGS 84
Semi-Major Axis	6378137 m
Inverse Flattening	298.257223563
Projection	Universal Transverse Mercator
UTM Zone	Zone 29 Northern Hemisphere
False Easting	500000 m
False Northing	0 m
Latitude of Origin	00^{o}
CM	009^{o} W
Scale Factor on CM	0.9996

The North Maidens Peak area should fall in the UTM zone 30 (being west of the 6°W parallel). But since all the other zones are in UTM zone 29, we decided keep this single set-up for all the acquisition.

2.2 Vessel

Survey operations were conducted from the survey vessel R.V. *Celtic Voyager* and all necessary geophysical and DGPS positioning equipment were pre-installed and tested prior to commencement of survey activities. The R.V. *Celtic Voyager* is a multipurpose research vessel owned and managed by the Marine Institute of Ireland.

Figure 2-1. The R.V. *Celtic Voyager*

2.3 Health, Safety and Environment (HSE)

All personnel joining the vessel were given a safety induction tour, which was fully recorded by the Vessel Safety Officer. All survey personnel held valid marine safety training certificates and medical certificates.

On-deck operations such as SVP casts, video camera deployment and grab sampling were under the control of the ships crew and were performed professionally, without incident and with personnel using correct PPE.

A muster and fire safety drill was conducted on the 17th September 2005.

2.4 Summary of Events

Prior to the start of this survey, a gyro calibration had been performed on the 16th April 2005 in Galway harbour. The bathymetric equipment (multibeam EM1002 and single beam EA400) had been fully installed and calibrated on the 30th April 2005. Therefore no other calibration was required apart from a bar check on the 17th September (Howth Harbour). The mobilisation of the other survey equipment (Pinger (SBP) acquisition and processing unit, and multibeam processing) started on the afternoon of the 16th September 2005, while the R.V. *Celtic Voyager* was berthed in Howth Harbour. All personnel were on board from 15h00.

The vessel departs Howth harbour at 12h00 on the 17th of September 2005. No data was collected during the transit. Survey operations commenced in the evening with the acquisition of one CTD-SVP cast. Survey operations started the 18th at 00h09 on North Maidens Peak site, acquiring MBES/SBES/Pinger and AGDS data. At 09H00 the site was almost complete and it was decided to start the collections of grabs (3 for biological and 1 for geological analysis) on 7 planned sites (position decided based on backscatter image). Due to strong tide current, it was found quite difficult to hold the position of the ship on the same point for 4 consecutive grabs. Grab operation were completed at 16h13 and followed by the restart of acoustic survey. The area was completed by 17h20 and transit started to the second area (Laconia Bank).

The Laconia Bank survey commenced on the 18th September at 22h15 (no side scan sonar acquired) with weather condition deteriorating quickly. The main Laconia Bank acoustic survey was completed the 19th September at 11h00 with the acquisition of 16 main lines. The survey had to be stopped due to bad weather conditions (33 knots of wind speed and about 2.5 to 3 m wave). No acoustic or sampling survey was possible until about 15h00.

At 15h00 on the 19th September, with the dropping of the wind, the vessel moved to the North Channel area to start full acoustic survey (SSS included). The weather did not improved sufficiently to attempt grabs or video camera survey.

During the acquisition of the first SSS line in about 115 m of water, 500m of cable was paid out and the speed reduced to 2.5knots in order to fly the SSS fish at about 20m from the bottom. With this speed, it was estimated that about 2.5 days would be required to complete the survey, and the range of the SSS was increased to 400m swath. At 17h00, the weather improved enough to start grab operations on Laconia Bank. At 21h30, 4 grab stations were completed in Laconia Bank. It was not possible to carry on grab operation (darkness), and the vessel returned to the North Channel site to continue the acoustic survey.

During the night, and with a good tide direction, survey continued with SSS at 4-5 knots and the main area was completed the 20th of September at 10h00. The weather was quickly deteriorating and it became impossible to run cross line. At 10h30, grab operations started in the North Channel area. This was completed at about 13h30, and operations returned to Laconia Bank to collect the remaining 2 grab samples.

At about 16h00 on the 20th, the remaining 2 grabs were taken and the vessel moved back to North Channel Area to attempt a UTV line, the camera could not be positioned on the bottom and the attempt failed.

At about 17h30, 2 more grabs were collected in this area, but only one in each site for geological analysis only. From 18h20 to 18h40 3 infill lines were surveyed on the NW corner of the area and on completion the vessel started transit to Hempton Bank.

The acoustic survey of Hempton Bank started the 20th of September at 21h44. Full acoustic equipment spread was used on site. The survey was suspended the morning of the 21st at 09:42 to start grabs and video operation. At about 17h40 of the 21st September the vessel transited to Greencastle location to collect grab samples. At 19:40 two sites (6 grabs) were collected. At 20h40, the acoustic survey of Hempton bank recommenced and operations completed on the 22nd September at 05h30. The ship returned to the Greencastle site to sample the third final site. The operation was successfully completed by 07h16. The ship then moved to Londonderry for port call. During the transit to Londonderry multibeam and pinger data were acquired as requested by Craig Brown (the pinger hard copy and digital copy of coda file, multibeam files and Hempton bank GIS were delivered to Craig Brown). A video camera light had to be replaced (broken bulb).

Ship arrived in Lisahally at about 11h50 on the 22nd for a personnel transfer: Niels Wijntjes joining and Craig Brown departing. The draft of the ship was measured and EM1002/EA400 draft was updated (5cm draft change). At 13h54 the ship departed Lisahally and went back to Greencastle to acquire 3 video transects. The video inspections were successful and completed by 19h00. The vessel then transited to North Islay, with weather quickly deteriorating. On site at about 23h00, the SVP was deployed.

At 23h15, with increasing bad weather (2.5-2.8m wave height and 35 knots of wind) attempts were made to survey. Considering the poor quality of the multibeam and pinger data, it was decided to transit to Colonsay Island (Scotland) for shelter.

The 24th of September at 07h50 the draft was measured and then the ship moved back to North Islay to carry on with the survey even with bad weather forecast for the day.

Figure 2-2. Sheltering in Colonsay Island

At 10h20 due to bad weather condition (gale force 8, 40 knots of wind, 3 to 4 m swell) and wind direction it was not possible to shelter in Colonsay and Lough Swilly identified as the closest

safe shelter. It was decided to change heading and anchor in Lough Swilly for shelter. Survey operations were suspended.

The 25th of September the Party Chief in agreement with Captain, MI and MTDS offices decided to abort the survey. Weather forecast for the coming week (from 26th to 30th of September) were very bad with wind force 8 to 9 and no sign of improvement. At 13h30 the ship start the transit to Killybegs and berthed at 23h30. No survey lines were recorded during the transit.

2.5 General survey information and results

Table 2-3. Survey MESH_05_01. North Maiden Area summary information

Sum of survey lines	26
Mainline	21
Crosslines	1
Infill	4
Number of svp/ ctd dips	2

Table 2-4. Survey MESH_05_01 Laconia Bank Area summary information.

Sum of survey lines	18
Mainline	13
Crosslines	2
Infill	3
Number of svp/ ctd dips	1

Table 2-5. Survey MESH_05_01 North Channes Area summary information

Sum of survey lines	18
Mainline	14
Crosslines	1
Infill	3
Number of svp/ ctd dips	1

Table 2-6. Survey MESH_05_01 Hempton Bank Area summary information

Sum of survey lines	19
Mainline	19
Number of svp/ ctd dips	1