| | |
|---|---|
| **Title:** | **Sub-tidal Workshop report** |
| **Author(s):** | J. Guinan |
| **Document owner:** | Marine Institute |
| **Reviewed by:** | F. Fitzpatrick |
| **Workgroup:** | n/a |
| **MESH action:** | 2 |
| | |
| **Version:** | 1.0 |
| **Date published:** | 15.06.07 |
| **File name:** | MESH Sub-tidal workshop.doc |
| **Language:** | English |
| **Number of pages:** | |
| | |
| **Summary:** | This report details the proceedings of the Action 2 sub-tidal workshop, held in the Marine Institute HQ on the 30th and 31st January 2007. |
| **Reference/citation:** | |
| **Keywords:** | MESH, Sub-tidal workshop, Ireland, Marine Habitat Mapping, Action 2 |
| | |
| **Bookmarks:** | |
| **Related information:** | |

| Change history | | |
|---|---|---|
| **Version:** | **Date:** | **Change:** |
| 1.0 | 14/6/2007 | |

This report should be cited as:

Guinan, J. 2007 *Mapping European Seabed Habitats (MESH)*. The report of the Sub tidal Workshop.

# Mapping European Seabed Habitats (MESH)

## Sub-tidal Workshop
## Marine Institute
## Galway

## 30th - 31st January 2007

This project has received European Regional Development Funding through the INTERREG III B Community Initiative

Prepared by Janine Guinan, Marine Institute

Reviewed by Fiona Fitzpatrick, Marine Institute

## Acknowledgements

We wish to thank the delegates who attended the Workshop from Ireland, the United Kingdom, Belgium and France, for their participation in the workshop and for their valuable feedback provided on current and future issues in relation to conducting habitat mapping in sub-tidal areas. We thank the speakers for their informative presentations. Thanks are due to our session chairs; Andy Wheeler (University College Cork), Tommy Furey (Marine Institute), Fergal Mc Grath (Marine Institute) and Neil Golding (Joint Nature Conservation Committee). We thank Micheal O Cinneide (Marine Institute) for acting as facilitator during the Open Discussion Forum. Thanks to our workshop rapporteurs; Sara Benetti, Jonathan White and Janine Guinan (Marine Institute). We wish to thank Pauline Ní Fhlatharta (Marine Institute) for organisational assistance.

## Summary

The following provides a summary of a workshop on the project Mapping European Seabed Habitats (MESH). The two-day workshop was organised for and by the Marine Institute on behalf of the MESH partnership. The aim of the workshop was to disseminate knowledge, evaluate methodologies and best practices for conducting deep-water survey methodologies with relevance to habitat mapping.

The Sub-tidal workshop attracted participants from a number of institutions (academic and private industry) in Ireland, the United Kingdom, Belgium and France. Many of the delegates who attended had experience in conducting habitat mapping in the sub-tidal zone. An important element of the workshop was to gain from this experience for future planning of deep-water habitat mapping studies, particularly in advance of a deep-water cruise to the southwest approaches (Ireland and the UK) scheduled for June 2007 as part of the MESH project extension.

Workshop presentations and discussions were divided across five sessions during the two days. An open discussion forum on the second day of the workshop provided an opportunity for delegates to discuss some of the more pertinent issues relating to habitat mapping in deep water and the utility of habitat maps. The workshop was important in bringing together the expertise of geologists, biologists and geophysicists working in the field of deep-water surveying and habitat mapping. The presentations provided practical information on survey design and survey technologies. Issues of scale and data integration for habitat mapping with acoustic and video data sets were also addressed. The discussion/open forum session was helpful in highlighting the rationale for conducting habitat mapping in relation to what the maps may be used for and what is required by the end user.

## CONTENTS

# 1. Mapping European Seabed Habitats – the MESH project

The Mapping European Seabed Habitats (MESH) project began in Spring 2004 as a trans-national marine habitat mapping programme. A consortium of 12 partners across the UK, Ireland, the Netherlands, France and Belgium received financial support from the EU INTERREG IIIB fund for the programme. The MESH partnership includes all five countries in the INTERREG IIIB north-west Europe area, and brings together the scientific and technical expertise in data collection and habitat mapping from all partners.

The aims of the MESH project were to produce habitat maps for north-west Europe (Fig. 1) and develop international standards and protocols for seabed mapping. The project will deliver a meta-database, and a web-delivered geographic information system (GIS) showing the habitat maps, guidance for marine habitat mapping including standards and protocols, case studies of habitat mapping along with a stakeholder database. The project has six work packages;

- generating habitat maps for northwest Europe
- developing standards and protocols for marine habitat mapping
- testing these protocols
- demonstrating applications of habitat maps for spatial planning and environmental management
- predictive modelling
- communicating the results

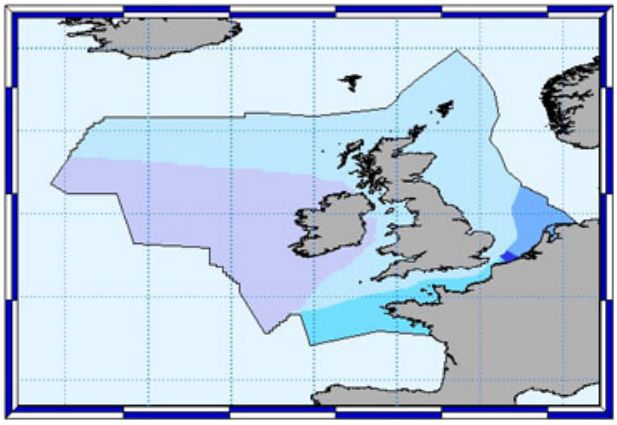


Figure 1. INTEREGG IIIB region northwest Europe defined by the area lying within the boundary. The coloured areas represent the country's Exclusive Economic Zone (EEZ) or equivalent.

## 1.1 Outputs of the MESH project

The main outputs of the MESH project are divided under a number of Actions for which individual partners are responsible. The outputs from MESH include the following;

- Seabed habitats maps for the north-west Europe INTERREG-IIIB Area, presented in a Geographic Information System (GIS) according to the European Environment Agency's (EEA) European EUNIS habitat classification system and the EC Directives types.
- A series of maps indicating the quality of mapping information in relation to its accuracy and precision at varying scales of resolution.
- A metadata catalogue of seabed mapping studies for north-west Europe.
- Internationally agreed protocols and standards for marine habitat mapping.
- Habitat mapping studies in new areas for testing, evaluating and improving the mapping protocols and standards.
- An evaluation of the practical application of the EEA's EUNIS habitat classification including recommendations for modification or improvement.
- Models for predicting habitat type based on physical and hydrographic information from different habitats and study areas.
- Case study examples to demonstrate the political, economic and environmental use of marine habitat maps for spatial planning and management at local, national and international levels.
- A framework in each country for the continued collation and improvement of habitat maps at national level and their compilation at an international level.
- A network of habitat mapping experts, practitioners and end-users in management, regulatory and planning authorities.

# 2. Workshop Introduction

Dr. Fiona Fitzpatrick (Marine Institute) provided an overview of the MESH project with particular focus on Action 2. This included an overview of the partners involved for those delegates not familiar with the MESH project. Some facts and figures including budget contribution from each country were presented. The specific goal of MESH was outlined;

> *"To establish a framework for mapping the marine habitats of north-west Europe through the development of internationally agreed protocols and guidelines for seabed habitat mapping and the generation of the first compiled marine habitat maps for the north-west Europe Interreg III B area".*

The drivers for MESH were identified along with the actions and deliverables. Specifically Action 2, for which the Marine Institute is the lead, is designed to develop standards and protocols for marine habitat mapping. The workshop was introduced and its context within the proposed canyons research cruise in summer 2007 and in contribution to the MESH Final Guidance document. The Final Guidance, one of the final deliverables of the MESH project, is designed to provide a methodological framework for marine habitat mapping. An interactive CD is being developed to ensure the data can be accessed is a readily usable format. The approach to the guidance consists of a series of chapters written in collaboration with all partners. Chapter titles for the Final Guidance include; (i) What is habitat mapping, (ii) What do I want to map, (iii) How do I collect my data, (iv) How do I make a map, (v) How good is my map, and (vi) What can I do with my map.

## *2.1 Workshop aims and programme*

The key objective of the sub-tidal workshop was to bring together biologists, geologists and geophysicists with experience of conducting deep water mapping surveys. The aim was to focus workshop presentations and discussions on the technologies and methodologies available for habitat mapping in deep water. As part of the MESH project extension, a survey is planned for June 2007 to map the distribution and extent of habitat in selected canyons at the south-west approaches. The objectives of the survey are to test the application of the survey standards and protocols as developed under the MESH project. The survey will also test the MESH guidance framework, providing a 'proof of concept' from planning through to conception. In addition, the survey proposes to investigate the biological communities found within, and in the vicinity of the canyon system, in the context of searching for areas appropriate for consideration as Special Areas of Conservation. In the context of the MESH extension canyons survey, the workshop aimed to discuss methodologies and survey techniques of relevance to the upcoming survey and future surveys in deep water and benefit from the expert group of scientists who have gained experience in the field.

The workshop was divided into five sessions (see Appendix 3 for programme).

**Session 1** focused on case study examples from the European continental margin, describing the hydrographic environment at the continental margin and the operating processes.

**Session 2** provided an overview of geophysical surveying in deep water including sedimentary research on channels and canyons south of the British Isles, seismic profiling, multibeam echo sounder (and video) data integration.

**Session 3** was an opportunity for delegates to learn of the use of remotely operated vehicles for deep water mapping surveys. Presentations in the session discussed a recent Irish university-led deep water mapping survey aboard the R.V. Celtic Explorer. Topics included ROV system integration and the integrated approach to ROV surveys acquiring video and acoustic datasets for habitat mapping and modelling.

**Session 4** provided an overview of techniques for biological investigations in deep water, in particular focusing on mapping and sampling devices and applicable techniques.

**Session 5** began with an overview of the research on canyons as part of the HERMES (Hotspot Ecosystem Research on the Margins of European Seas) project, including research on canyons surveyed as part of HERMES. Submarine canyons in the northern Bay of Biscay margin were also discussed. The final talk of the session provided an overview of current habitat classification schemes.

# 3. Summary of workshop presentations

## *3.1 Session 1-Case study examples from the European Continental margin I*

*Active along- and down slope processes on the Continental Margin of North Bay of Biscay to Goban Spur - Dr. Mike Cunningham, UK Maritime and Coastguard Agency*

Dr. Mike Cunningham presented the results of the investigation of active sedimentary processes on the Bay of Biscay slope (Celtic margin). He stressed the importance of the successful collaboration with telecommunication companies that allowed access to an otherwise-undisclosed large amount of data. The compilation and analysis of all available data sets, from swath bathymetry to pinger profiles to core records, was carried out in a free Geographic Information System (GIS) environment (Grass) with quality control in mind. The results contributed to a risk assessment model for the posing of submarine cables. Results were also discussed in a scientific paper recently published in Sedimentary Geology (2005, vol. 179), where along-slope and down-slope sediment dynamics are analyzed. The main findings report include (i) active down canyon transport in the mid to lower slope, with spill over of fine-grained turbidity currents, (ii) sand transport into canyon heads, and (iii) along slope transport of fines.

*Preliminary hydrographic results from the Gollum Channel – Dr. Martin White, National University of Ireland, Galway*

In the second presentation, Martin White reported on the preliminary results from an exploratory hydrographic survey with two moorings in the Gollum Canyon. Unfortunately, only one of the moorings was recovered biasing the findings to the hydrographic conditions at 900 meters water depth. Temperature and salinity profiles did not show any changes in water mass structure, ruling out the cascading of dense/cold water that has been observed in other canyons on European margins. The mean current is around 5 cm/sec, being quite stable and directed down-slope, with some low frequency variability dominated by semi-diurnal tides. These results suggested the future ROV will not be troubled by unusually fast or changing currents along the canyon. Problems outlined by this survey include biological fouling, which affected velocity measurements after ca 6 months, and the short life span of the turbidity sensor. It also showed how the timing and depth of deployment of sensors should be planned with care if the aim is to record processes that may happen only at certain times (e.g. dense water cascading is likely to happen in winter), especially for sensors with a likely short working life. However incomplete the results may be, they provide important information to be used for future survey planning.

## 3.2 Session 2: Geophysical surveying in deep water

*Seismic profiling in deepwater – Dave Long, British Geological Survey*

In the first talk of Session 2, Dave Long highlighted the fact that 55% of the MESH study area lies in deep-water. The trade-off between high frequency and low frequency systems was discussed. A problem in deep water is that as a result of the distance of the source/receiver from the seabed, more energy is required to travel through a greater depth of water for a sufficient echo return. A solution to this problem is to move the source and or receiver closer to the seabed. The various equipment available for surveying in deep-water were discussed, e.g. airgun, sparker, boomer and pinger. Examples of TOPAS data (from Hatton Bank) and Parasound data were also shown. The presentation then moved towards the underwater platforms used in deep-water surveying e.g. Autonomous Underwater Vehicles (AUVs) with the HUGIN AUV, depth rated to 3000m, shown along with the REMUS (USA) and GRAVIA (Iceland) AUVs. Considerations for planning deep-water surveys were outlined e.g. transit times to deep-water regions, weather, and the importance of using existing data to plan the survey. Deep towed devices are at risk when surveying in irregular or unknown terrain and care is required to avoid damaging equipment. Planning the orientation of the survey lines will assist in data interpretation. For surveys of seamounts, a radial survey design was suggested to ensure information from all flanks of the mound is required. In areas of flat seafloor, survey lines should consider the oceanographic regime. In relation to surveying canyons, it was suggested that deep-tow systems should be towed in the direction of down-slope in the canyon (not up-slope) and survey speeds should be typically 4-5 knots. Survey lines should be long in duration so as to minimise the occurrence of turning the vessel.

### *From the far to the near – data integration and resolution: lessons from deep water surveys - Dr. Andy Wheeler, University College Cork*

Andy Wheeler discussed the issue of scale and the appropriate survey tools to be employed which will affect the quality of the data and the type of questions which can be answered of the data. For regional scale mapping, Multibeam echosounder (MBES) surveys can map large areas effectively however, resolution decreases with depth. The TOBI deep-tow system has been used to map areas of the Irish continental margin resulting in excellent backscatter data however, positioning information is not accurate. The importance of integrating datasets with video so that features present in the video can be related to features on the seabed was highlighted. Mapping at a resolution so as to understand the different processes occurring at the seabed was also discussed. The use of video on Remotely Operated Vehicles (ROVs) for ground-truthing acoustic data assists in the understanding of benthic habitats. Video and acoustic datasets are integrated allowing for better data interpretation. ROVs allow control on data acquisition. Moving back to the acoustic data, MBES and sidescan sonar drapes are powerful tools for allowing better interpretation of the data. Video data from the vertical camera can be mosaiced to allow further interpretation of the data.

### *Multi-disciplinary deep-water sedimentary research on channels and canyons south of the British Isles - Dr. David van Rooij, University of Ghent*

The final speaker in the session was David van Rooij (University of Ghent) who presented his research on channels and canyons south of the British Isles. Three case studies were presented from the Gollum Channel System (GCS), La Chapelle Bank and the Whittard Canyon. High resolution seismics were conducted at each study area. The GCS is thought to combine two distinct canyon systems; the Kings channel and the Gollum channels. Some of the features of the Kings channel are: 1) weakened down slope currents, 2) mass wasting features, and 3) down slope feeder channels. The Gollum channels are characterised by turbidite activity during lowered sea-level and stronger bottom currents at interglacial periods. The morphology of La Chapelle Bank was described from seismic imagery and ROV video observations revealed the biology at the study area. The findings of the research indicate a new “forgotten” deep-water ecosystem and suggest the influence of topography in this hydrodynamic environment. An association with deep-water corals is a possibility and further investigations of the study area will be carried out during the R.V. Belgica cruise in 2008. The final study area at the Whittard canyon was mapped in co-operation with the GSI and revealed possible coral banks and the related hydrodynamic environment. Many of the questions raised during the course of this research will be addressed during the R.V Belgica cruise in 2008.

## 3.3 Session 3: Using Remotely Operated Vehicles (ROVs) for deep water surveys

### *The use of ROVs for offshore benthic surveys in Irish water - Dr. Anthony Grehan, National University of Ireland, Galway*

In the first presentation of Session 3, Anthony Grehan provided a chronology of ROV surveys conducted in Irish waters to date, highlighting ROV infrastructure available in European Institutes. As part of the Irish Government's PRTLI Cycle 3, the National University of Ireland (NUIG) signed a Memorandum of Understanding (MOU) with the Geological Survey of Ireland (GSI) to gain access to data available from the Irish National Seabed Survey (INSS). Bathymetry data were used in multi-scale terrain analysis, deriving parameters of relevance to benthic habitat. Terrain parameters such as slope, rugosity, curvature and aspect were derived from bathymetry data and integrated with underwater video data sets. INSS bathymetry data provided base maps for the first Irish University-led deep water ROV habitat mapping survey in 2005. Carbonate mounds were the focus of ROV surveys at locations in the Porcupine Seabight and on the Porcupine Bank. Data acquisition included ROV multibeam data and ROV-based video (vertical and oblique views) supported by a high quality position and motion data using Inertial Navigation System (INS) and Doppler Velocity Log (DVL) (IXSEA PHINS). The ROV surveys revealed the fine-scale structure of carbonate mounds with bathymetry data gridded at 0.5m grid cell size (versus 25m with INSS data). Multi-scale analysis examined the relevance of these fine-scale bathymetry data for deriving terrain parameters and linking to video data. These data have been used to predict beyond the track of the video by developing habitat suitability models with ROV bathymetry data. The final part of the presentation highlighted survey considerations for conducting habitat mapping in deep water. Key considerations included tidal currents, weather, and the importance of a tether management system with the ROV to ensure quality data acquisition.

### *Challenges of ROV system integration for deep water habitat mapping - Dr. Dan Toal, University of Limerick*

An engineering/technical perspective was presented by Dan Toal in the context of providing accurate position and motion information of the underwater platform. Whilst in shallow water this can be obtained from the surface vessel, in deep water there is a requirement for this information to be satisfied using a combination of inertial navigation and Doppler Velocity Log information. The importance of navigation and positioning was highlighted with reference to the high performance positioning system used on the Bathysaurus ROV during a habitat mapping survey on the R.V. Celtic Explorer in 2005.

### *An integrated approach to ROV surveys: mapping and modeling benthic habitat using ROV-based video and multibeam data sets – Dr. Janine Guinan, Marine Institute/National University of Ireland, Galway*

In the last talk of the session on ROV habitat mapping, Janine Guinan presented an approach to mapping and modelling the cold-water coral habitat using ROV technology. The presentation was related to the previous two talks in the session, discussing the use of video and multibeam echo sounder (MBES) data collected aboard the R.V. *Celtic*

*Explorer* in 2005 using the Bathysaurus ROV. High resolution MBES data were acquired using a Reson SeaBat 8125 system. ROV altitude for multibeam acquisition was tested between 20 and 60 m above the seafloor. ROV-based video observations from vertical and oblique views provided information on benthic habitat, and were useful for ground-truthing MBES data. The benefits of using data from both camera views were highlighted. Information from the vertical camera can be used for image scaling (% abundance estimates), species presence data for ecological modelling, ground truthing of acoustic data, facies descriptions and for geo-referenced image mosaics. The oblique view is useful for providing context to imagery acquired by the vertical camera. Additionally the oblique view provides information on water column species. Image scaling on the vertical camera allows for quantitative estimates of species where the image size is known. This method has proved successful for estimates of % cold-water coral in imagery acquired from the vertical camera on a ROV. The relationship between % coral abundance and terrain parameters (slope, rugosity, curvature) was examined with terrain parameters derived from the INSS bathymetry data. The final part of the talk presented a short introduction to the applicability of these data sets for ecological modelling. Using terrain parameters in combination with species occurrence data, ecological models can be developed predicting the habitat suitability for cold-water coral habitat beyond areas sampled.

## 3.4 Session 4: Biological investigations in deep water

### *Survey of deep-sea features NW of Scotland; the SEA/SAC surveys and what we have learned from them - Dr. Kerry Howell, University of Plymouth*

In the first talk of Session 4, Kerry Howell described a survey of deep-sea features north-west of Scotland; the SEA/SAC surveys and what we have learned from them. For example, Annex I reef and boulders were the targeted habitat class for this work. Surveys undertaken in 2005 & 2006 employed the Simrad EM120 and EM1002 MBES, respectively. A drop frame video and stills camera system from Seatronics was used. The set up in the second year proved very productive and well coordinated. Having winch control, camera control and vessel navigation side by side was critical to the successful operation. Targeted survey areas were stratified by depth and bottom type. Primarily hard substratum was targeted, with some soft substratum providing contrast to the backscatter strength observed. The MESH survey design was adopted for the second survey to provide unbiased collection of stills images (Figure 2) at one minute intervals. Additional stills were taken where changes in substrata/ habitat and species identification were observed. Quantitative images were acquired as standard when the camera frame rested on the bottom; additional shots from above were collected to contextualize quantitative images. Still frame images are of higher resolution enabling greater magnification of taxa for ID.

Quantitative analysis of stills was performed with the aid of an overlaid lattice. Video analysis was used to put stills data into context – to map their distribution along the survey track. Classification was in the first instance geophysical, with community analysis secondary on top of this.

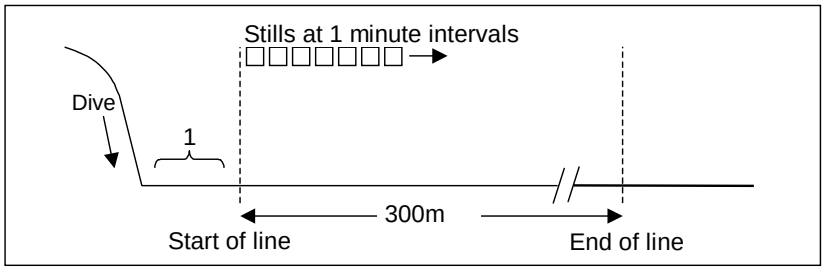



Figure 2. MESH recommended deployment strategy for stills collection including stabilisation time of 2 to 5 minutes at "1", adopted for SEA/SAC surveys.

The lessons learned from the survey:

- In 2005, three camera systems were used, which were interchanged – future work should follow a standard setup.
- In 2005, two one-month independent surveys were undertaken – geological then biological. In 2006 one integrated three month survey was undertaken, proving more fruitful.
- A coordinated vessel with winch and camera control in 2006 proved critical.
- Accurate camera underwater position fixing critical – do not rely on layback.
- Image quality tends to be increased with depth owing to improved visibility.
- Quantitative data is achievable with drop frame configuration, where the frame can land owing to known field of view – laser scaling may extend range of quantifiable images.
- Camera frames can be used in higher sea states than ROVs and are simple to deploy
- Camera frames cannot be so easily directed away from a set survey line by 'interesting' features as ROVs may be potentially bias in favour of more uncommon features.
- Camera frames cannot look around and become 'distracted'.
- Camera frames cannot land on steep slopes, so presenting problems of standardised field of view. This may potentially be resolved through forward looking camera and laser point scaling.
- Physical samples can not be collected by camera drop frames.

### *Mapping and sampling strategies for the study of deep benthic ecosystems using ROVs - examples from coral reefs and cold seeps, Dr. Karine Olu, IFREMER*

Karine Olu discussed mapping and sampling strategies for the study of deep benthic ecosystems using ROVs with examples from coral reefs and cold seeps. The 2001 survey of the Theresa mound in the Porcupine Seabight, covered approximately 1 km2 using ROV. An altitude of 3m height above the seafloor proved the maximum for identification. Post processing of the video data was performed with Adélie extension for ArcGIS. Navigation files and video recorder with time stamp information.

Output:

- Maps of habitat (substrata and dominant taxa)
- Maps of mega fauna species distribution and pots of single observations
- Maps of estimated faunal abundance

Process involves:

- Definition of habitat classification
- Drawing of buffer zones either side of the ROV video survey line for each habitat
- Checking based upon stills images
- Listing of recognised species on video and check against sampled specimens
- Coupling of habitat maps and mega faunal maps
- Define habitat preferences of species
- Species abundances from downward looking camera

Karine described how Adélie Software developed by IFREMER automatically divides the dive into set sampling units of standard size (e.g. 100 m2). From these units, species-abundance matrices are compiled for quantitative assessmen and establish patch/colony sizes and species abundances. MATISSE Software developed by IFREMER enables predictive mapping of habitats from kriging, which is applied to the geo-referenced video mosaic. Equipment employed the collection of physical samples has included grabs, cones, boxes and suction devices.

### *Deep marine sampling: strategies, devices and techniques - an overview, Dr. Boris Dorschel, University College Cork*

In this presentation, Boris Dorschel presented an overview of the devices and techniques which may be applied to sampling in deep water.

Review of survey design constraints:

- Coverage *vs*. resolution
- Hot spots *vs.* general picture
- Quantitative *vs.* qualitative
- Accuracy and position – ships position or sample device position
- Project requirements of the survey
- Statistical constraints on sampling

Review of marine sampling tools:

- Water sampling – CTD rosette
- Single plankton nets
- Multi-plankton nets
- Bottom lander sediment traps - generally deployed for 12 to 18 months;
- Pump systems for suspended particulate matter (e.g. SAPS - Stand Alone Pump System);
- Dredges & bottom trawls
- Short cores and grabs – from TV grab, large volume for geology, (0.75 $m^2$), to Van Veen grab, fast biological sampling; consideration necessary of positioning systems for grabs – influence of currents
- Box corer – sedimentary and biological layering preserved, good sample quality
- NIOZ pip box corer incorporating neoprene top and bottom seals
- Multi corer with 6 plus tube samples collected simultaneously
- Gravity corer
- Piston corer
- Drilling devices and vibrocorer
- ROVs
- Lander systems

Consideration is required to encompass the combination of techniques in relation to the desired data return and water depths. Replicate and or sub-sampling routines will need to be determined. Checklists for routine operations are strongly recommended for even the most obvious of routines to ensure practices are followed and all samples and records made. A combination of photographic and video with grab/core sampling equipment lends advantages and disadvantages, enabling the collection of imagery of grab sample position prior to disturbance by the grab and the sample in context with its surroundings. This may provide for targeted sampling as opposed to random sampling, potentially biasing samples toward items of interest.

## 3.5 Session 5 Case Study examples from the European continental margin

*Research on canyons within the HERMES (Hotspot Ecosystem Research on the Margins of European Seas) Integrated Project - Prof. Phil Weaver, National Oceanographic Centre, Southampton*

Session 5 was again focussed on case studies on European canyons. Phil Weaver presented the analysis of bathymetric, side scan sonar and core data collected in several cruises on the Portuguese margin within the framework of HERMES (Hotspot Ecosystem Research on the Margins of European Seas). Several suggestions for the study of canyon environments emerged from his talk:

(1) Even if the focus is a canyon, surveys should be planned so to gather data from non-incised areas as well to provide a comparison for sedimentological and biological processes.
(2) Side scan sonar should be towed always downslope along canyon axis.
(3) Upper reaches of canyons are normally deeply incised and very steep. To be sure to land any sampling equipment in the right position, there is the need for good quality data and positioning systems before proceeding to sampling.
(4) Another problem is the successful sampling of canyon thalwegs because of the presence of rock outcrops or very coarse sediment.
(5) Even when the canyon floor is completely flat, the backscatter response may differ reflecting the action of currents that have transported and reworked sediment. The information that may be gathered by sampling these areas of different backscatter is as important as that collected in other canyon sections.
(6) A multicorer is a good option to sample the top few centimetres of the seabed where most of the biological activity takes place.
(7) Hydrographic surveys may integrate sedimentological and biological studies of canyons providing additional information on sediment transport and flows along canyon.

### *Geomorphological overview of submarine canyons in the Northern Bay of Biscay Margin, Dr. Jean-Francois Bourillet, IFREMER*

Jean-Francois Bourillet (IFREMER) presented a geomorphological overview of the submarine canyons in the Northern Bay of Biscay margin. Longitudinal profiles and different drainage pattern of these canyons were discussed with reference to canyon formation processes and typologies of sediment transport. The focus of the talk was on the importance of the shelf break as a key area for sedimentological and biological processes. One main question emerged from the talk: which is the best area for habitat mapping in canyons? Canyon floors are often washed down, while canyon flanks are steep and both areas are difficult to sample. Perhaps the best option is to survey interfluve areas, which are still largely unknown, but seem to boost life, as also testified by intense fishing activity in such areas.

### *Habitat classification – an overview of current classification schemes - Dr. Fiona Fitzpatrick, Marine Institute*

Fiona Fitzpatrick (Marine Institute) added a different spin to the final talk of this session. Fiona presented an overview of the current deep water habitat classification techniques. The three main approaches are EUNIS (2004) that of Roff and Taylor (2000), Roff et al. (2003) and that of Greene et al. (1999). All classifications rely strongly on geological/geomorphological features and mainly lack a biological side to them. Additionally, they are often difficult to apply if mapping with remote sensing techniques, as one would do in deep water. Canyon environments are becoming the focus of habitat mapping for their importance as havens for marine life and the necessity for regulating their exploitation by fishermen, but it appears that the existing classification techniques are inadequate for use in deep water. Which should be the way forward? Do we need to populate EUNIS or use other classifications or a combination of the above? A consensus within the scientific community should be reached.

# 4. Presentation Abstracts

## An evaluation of regional active along-slope and down-slope processes of the NW European continental margin

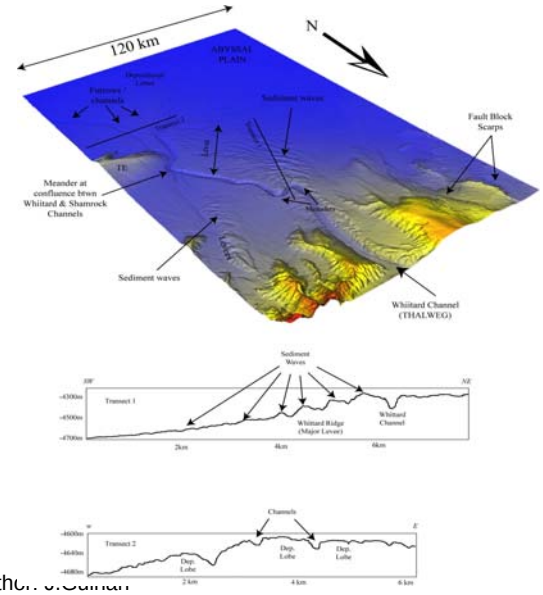
M.J.Cunningham*, L.M.Parson, D.G.Masson and S.Hodgson

*National Oceanography Centre, University of Southampton, European Way, Southampton SO14 3ZH, United Kingdom.*

*Corresponding author: mjc1@noc.soton.ac.uk.

In recent years, there have been a number of detailed but small scale studies of sedimentary processes on the NW European continental margin. These previous studies have tended to focus on the continental rise and abyssal plain with only brief evaluations of down-slope sedimentary processes. On the larger scale, there is insufficient knowledge of active sedimentary processes from the continental shelf to the ocean floor, particularly along-slope processes. Traditionally, there are only a few studies, which have integrated the interactions of along-slope and down-slope processes. These include sedimentary slides, gravity, debris and turbidity flows, and contourite deposition. An evaluation of these processes and consequent interactions were undertaken to create a clearer understanding of sedimentary processes, and their implications for cable routing. This also includes the citing of appropriate routes in less than 2000m water depth where sufficient soft sediment and gentle slopes are present to increase protection of submarine cables from fishing trawlers.

Fig. 1 Perspective bathymetry of continental rise and abyssal plain. the channel begins to meander. At this point, overbank flows from the channel form large fields of sediment waves extending over 60km to the SW, forming a major levee. Levees also form on the eastern part of the channel but to a lesser extent (10km wide zone). Further west, levees have developed on the western banks of the Shamrock Channel. This channel converges with the Whittard Channel further south and is deflected to the right around an EW trending topographic ridge.



## Deep marine sampling: Strategies, Devices and Techniques – an Overview

Boris Dorschel

*Environmental Research Institute, Marine & Freshwater Research Group, Lee Road, Department of Geology, University College Cork, Cork,, Ireland*

Corresponding author: b.dorschel@ucc.ie

Since the start of deep marine research, the technological progress has constantly pushed the limits of 'what can be done' to deeper and more difficult realms. Starting off with blocks of wax lowered to the seafloor to which sediments and organisms stuck, we have now reached remotely operated or even autonomously operating equipment. But even though this high-tech equipment is available, the majority of marine research activities are still carried out with conventional mechanical sampling devices as they are robust and easy to handle.

This presentation will therefore focus on such 'workhorses' (water sampler, gravity/piston corer, box corer, multi-corer) as well as on the sophisticated equipment such as remotely operated vehicles, landers and autoclave corer. The third part of the presentation discusses sampling strategies and their pros and cons. This includes strategies for sampling campaigns as well as individual sub-sampling.

## Deepwater classification techniques - a brief review

Fiona Fitzpatrick

*Advanced Mapping Services, Marine Institute, Rinville, Oranmore, Galway*

Corresponding author: Fiona.Fitzpatrick@marine.ie

Globally, the deeper water realm remains relatively unexplored and only a few countries have attempted to develop a structured approach to deep sea floor classification. Although the classifications have been designed following certain conventions, and the resolved units are identifiable, repeatable and representative of the full range of sub-tidal habitats, they are very diverse and employ a combination of true habitats and geomorphological features. Considering the fact it represent the MESH project preferred solution, the divisions which EUNIS classifies the deeper waters are examined; showing the requirement for further development and revealing a mixture of habitat and landscape types, resolved by a mixture of ground truthing and remote sensing techniques and rarely extending beyond EUNIS level 4. The Roff and Taylor (2000), Roff et al. (2003), Greene et al. (1999) and Vincent et al. (2004) classifications are examined, in terms of their applicability to the intended deep water work planned by the MESH partners in the South Celtic Sea. The national approaches taken by the USA and Australia are briefly reviewed; highlighting the similarities in syntax.

## An integrated approach to ROV surveys: mapping and modelling benthic habitat using ROV-based multibeam and video datasets

Janine Guinan[1†]*, Margaret Wilson[2†], Anthony Grehan[3], Colin Brown[3]

[1]*Advanced Mapping Services, Marine Institute, Rinville, Oranmore, Galway*
[2]*Geological Survey of Norway, Trondheim, Norway*
[3]*Department of Earth and Ocean Sciences, National Univerisity of Ireland, Galway*
†*Previously at the Department of Earth and Ocean Sciences, National University of Ireland, Galway*

*Corresponding author: Janine.Guinan@marine.ie

The Irish National Seabed Survey (INSS) has mapped seabed features in deep water areas (> 200 m) west of Ireland. Whilst these data have been useful in identifying broad-scale features, the resolution of fine-scale features of relevance to habitat mapping is decreased with increasing water depth. Underwater platforms such as remotely operated vehicles (ROVs) have evolved as important tools for investigating the seabed at a higher resolution. ROV-based video multibeam echosounder (MBES) data were acquired during the first Irish University-led deep water habitat mapping survey in 2005. ROV-based video and MBES acquisition was supported by a high performance inertial navigation system. Video imagery was acquired from video cameras positioned for vertical and oblique viewing. Imagery acquired in this way has applications for quantitative species abundance estimates, ground truthing of multibeam data, facies descriptions and water column observations. ROV MBES data were acquired from different altitudes (20 m, 40 m and 60 m). An integrated approach to ROV surveys involved conducting video transects within the MBES swath but offset from the nadir to avoid inferior quality data associated with this region (Figure 3). Terrain parameters derived from INSS bathymetry data combined with species information from ROV video have been used to develop robust habitat suitability models showing potential distributions of cold-water corals at unsampled areas. Ecological models such as those presented here can be used to predict species distribution in unsampled areas, and in preliminary conservation assessments.


Fig. 3 Integrated approach to ROV-based video and multibeam echosounder habitat mapping. The video transect is offset from the nadir region of the multibeam swath to avoid inferior quality data acquired from this region.

## Seismic profiling in deepwater

Dave Long* and Dave Smith,

*British Geological Survey, United Kingdom,*

*Corresponding author: dal@bgs.ac.uk

Deepwater, beyond the shelf break (>200m water depth), represents ~55% of the MESH area. Although low frequency, surface towed seismic systems such as airguns and sparker will provide profile information the seabed resolution is a metre or more. To get finer resolution high frequency sources need to be used e.g. boomers, pingers, however, when towed at the surface much energy is dispersed, reducing the strength of the echo and covering a wide footprint. This can be overcome if the source and/or hydrophone are placed close to seabed, allowing improved along track resolution. Deep tow boomer profiles allow interpretation of seabed sediments to indicate which sedimentary processes are active in the area. They can also show the closeness of rockhead to seabed. Airguns, sparkers, boomer and pingers are typical systems for regional surveys. These are all operated from a vessel, however alternative systems utilising AUVs (automated underwater vehicles) often used in the hydrocarbon industry, allow finer detail to be collected for small areas and as costs come down may well be considered for scientific surveys in the future.

Planning a seismic survey requires optimal use of expensive equipment including the vessel. This may mean running seismic systems simultaneously with careful management of the vessel when turning if several cables are towed. Survey line orientation on slopes should consider side wall reflections that can obscure the seabed as features on the seabed can present differing aspects to single line surveys.

# Challenges of ROV system integration for deep water habitat mapping

Dan Toal*, Edin Omerdic and James Riordan

*Mobile and Marine Robotics Research Group, University of Limerick, Ireland*

*Corresponding author: Daniel.Toal@ul.ie

Imaging for habitat mapping of the seabed at requisite image resolution requires high frequency sonars to be flown close to (~30m altitude above) the seabed. In shallow water this can be achieved with sonars (e.g. multibeam or sidescan) mounted on a surface vessel, which is equipped with GPS & platform motion reference sensors for generation of georeferenced imagery. For habitat mapping in deeper waters again the sonar must be flown relatively close to the seabed. However the positional and motion reference accuracy of the sonar platform becomes a limiting factor as GPS fixes are unavailable. At significant depth the positional accuracy of the imaging sonar platform is less than the resolution of the sonar imagery which becomes a limiting constraint on the generation of wide area habitat (high resolution) maps. This paper details the state of the art solutions for deep habitat mapping and describes the Positional Accuracy v Resolution Trade Off & Importance of Navigation / Positioning coordinate reference frame. The navigation / positioning complex used with multibeam sonar on the Celtic Explorer in June 2005 during habitat mapping of cold water corals in the Porcupine is described.

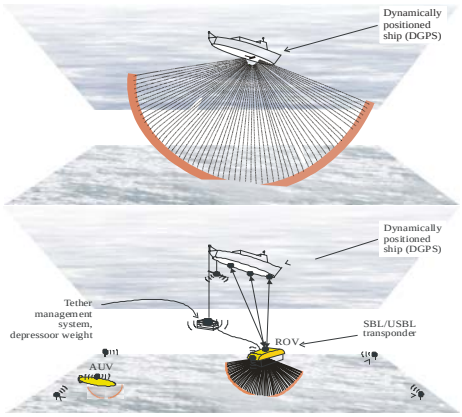



Figure 4 Habitat mapping requires high-resolution sonar imagery with video ground truthing. ROV mounted sonars are ideal for this task though vehicle position / attitude .estimation errors become a considerable technical constraint.

Figure 5 Bathysaurus ROV being deployed from RV Celtic Explorer for high Resolution Seabed mapping on the Porcupine Bank.

# Multi-disciplinary deep-water sedimentary research on channels and canyons south of the British Isles.

David Van Rooij

*Renard Centre of Marine Geology, Ghent University, Krijgslaan 281 S8, B-9000 Gent, Belgium.*

Corresponding author: david.vanrooij@ugent.be

Over the last decade, the RCMG at Ghent University (co-) organised and participated in several geophysical and sedimentological campaigns to the Gollum channel system, off Ireland. The study mainly focused on the structure and development of the upper slope branches during the Neogene, framing within the objectives of several European projects (ENAM2, Geomound, HERMES). Recently, in June 2006, a joint geological-biological research cruise also included the La Chapelle bank and the Whittard canyon, within the framework of the current EC FP6 IP Hermes. The general objective of this campaign was to cross-cut several disciplines and tasks within the Hermes project. As such, it was aimed to get a complete picture on how biodiversity, sedimentological processes and physical factors are linked to each other and how they can control the various deep-water ecosystems along the European Margin. In this paper we will highlight will the used methodologies and main (preliminary) results.

The most elaborate data set was collected on the upper slope of the Gollum Channel system. Additional to the RCMG high-resolution seismic profiling, campaigns organised by associated partners acquired multibeam bathymetry (Beyer et al., 2003), TOBI side-scan sonar data (Wheeler et al., 2003) and a long piston core in one of the channels. The main Gollum channel system is characterised by several deeply incised canyons with numerous slide scars on their flanks. Their pathways seem to be influenced by a structural control, creating a bayonet-shaped course. Upstream of this structural feature, the channel floor deposits are characterized by thick acoustically transparent units suggesting ponded turbidites or mass-wasting deposits. Piston core MD01-2464, however, only yields a small number of fine-grained turbidites in a muddy hemipelagic host sediment. This suggests that this system has known a relatively low activity during Quaternary times. The survey near the French canyon system near the La Chapelle bank offered a perfect location for trials of Ghent University's ROV GENESIS. The area was first surveyed using a multibeam echosounder, imaging deep canyons and thalweg channels between prominent spurs where previously corals had been reported. High-resolution seismic sparker lines provided a geological context and linked in to the existing seismic stratigraphy. During this survey, dense communities of unidentified giant oysters associated with occasional cold-water coral colonies were discovered on fallen block near 10 m high cliffs.

The survey on the Whittard canyon system was originally designed to better document its morphology and structure and to assist finding suitable places for biological sampling. During this survey, a set of enigmatic mound-like structures were found in water depths of 300 to 500m, very much alike the coral banks observed in the Porcupine basin (IODP 307 Expedition De Mol et al., 2002; Scientists, 2005). They are closely associated to a down slope gully of the Whittard canyon and some levee (or even drift) deposits. The presence of coral banks in this canyon location would be a perfect example of valuable ecosystem hotspots.

## Research on canyons within the HERMES (Hotspot Ecosystem Research on the Margins of European Seas) Integrated Project

Phil Weaver

*National Oceanography Centre, Southampton, United Kingdom*

Corresponding author: ppew@soc.soton.ac.uk

The EU funded project HERMES includes a large amount of work on submarine canyons. Two examples of canyon research were presented, the Nazare Canyon off Portugal and the canyons in the Gulf of Lions. Canyon survey techniques have improved dramatically in recent years with the development of swath bathymetry. Even greater detail can be obtained via the use of deep-towed sidescan sonar, as has been revealed by a recent TOBI survey of the Nazare Canyon. The TOBI data shows the precise position of the thalweg, the width of the canyon floor, position of channels in wider areas of canyon floor and many features on the canyon walls such as gullies and landslides. It also shows the positions of terraces, which often accumulate sediment and therefore provide coring targets. Coring and biological sampling sites were identified and targeted using the sidescan and swath bathymetric data. Long piston cores show rapidly accumulated sediments on some terraces and evidence of deposits left by sediment flows associated with the 1755 Lisbon earthquake. They also show that sedimentation rates were much greater during glacial periods, when sediment flows were extremely frequent.

A number of data sets have been collected in the Nazare Canyon including CTD stations that have provided temperature and salinity profiles along canyon. These profiles show a high salinity layer at about 1100 mwd caused by Mediterranean outflow water. Current speed data exceeds 10 cm/s a few metres above the canyon floor, but declines down canyon. Areas with rapidly deposited mud have very high numbers of Holothurians, whilst near the canyon mouth Xenophyophores are extremely abundant on the seabed. Further studies of the biology are now planned using an ROV and targeting sites based on the combined background data. The second example is the Gulf of Lions where a broad shelf separates a number of rivers from a series of offshore canyons. Sediment entering the gulf from the rivers is swept westwards around the gulf with the greatest proportion entering the Spanish Cap Creus Canyon and thence passing to deep water. Recent surveys of this canyon using swath bathymetry show many erosional features caused by the -frequent sediment flows. Recent results also show increased levels of pollutants in the sediment in the canyon.

With much of the background physical information now known for many of the HERMES study areas, the biology can be studied in context, so that an overall picture can be built of the ecosystems and their environments.

Sampling strategies have been devised that require a wide range of data sets (biological and physical) to be collected at a small number of predetermined depths, both within the canyons and at the same depths on the adjacent continental slopes. This strategy will enable an analysis of variations in ecosystems down-canyon and a comparison of ecosystems in and out of the canyons at comparable depths. The examination of a number of canyons will also enable variations between canyons to be assessed.

## From the far to the near - data integration and resolution: lessons from deep-water surveys

Andy Wheeler

*Department. of Geology & Environmental Research Institute, University College Cork.*

Corresponding author: a.wheeler@ucc.ie

Underwater scientific investigations occur on many scales depending on the type of research questions being posed. Choosing the appropriate survey tool will affect the resolution of the survey that is inversely correlated to the area of survey. Therefore, the choice of survey tool will affect both the quality of your answer and what you can answer. Blending survey approaches and effective data integration is vital to cost-, data- and time-effective research. A range of options are available. Hull-mounted multibeam echosounder (MBES), especially in deep water lend themselves to exploration and discovery strategies and may provide excellent base maps upon which to base further study. Resolution decreases with depth; a real problem below 1000 m although large areas can be mapped. Deep-towed systems (both MBES and sidescan sonar (SSS)) can overcome this with the 30 kHz TOBI SSS system being a good compromise between survey swathe (6 km) and resolution. High frequency deep-tow MBES systems are now also available. TOBI produces excellent backscatter allowing geological interpretations superior to those available from MBES backscatter. At high frequencies, e.g. 100 kHz, resolution is at the scale of large bedforms facilitating seabed process studies and the resolution of small features. At 410 kHz, fine scale features, also visible on video, can be imaged. Skill and caution are required deep-towing 410 kHz SSS which should be flown 10m above the seabed. Video and/or sampling is the necessary final step to ground-truthing all SSS and MBES coverages. Most scientific studies benefit from surveying at a range of scales with effective data integration. Combining SSS backscatter data with MBES bathymetry adds confidence to interpretations. Combining MBES or SSS with video groundtruthing is a common and powerful tool. Video frames can be assigned to a facies and coded in a GIS. Numerous GIS extensions, e.g Adélie, add extra functionality allowing images to be hyperlinked to the facies coded video line overlaid on the basemap as well as GIS-controlled video viewing functionality. Advances in video mosaicing also facilitate very high resolution mapping. Effective data integration of datasets at differing scales of resolution allow robust facies maps to be generated which, if integrated with biological data, can form the basis of habitat maps.

## Preliminary results from hydrographic measurements at Gollum Channel

Martin White

*Department of Earth and Ocean Sciences, National University of Ireland, Galway, Ireland*

Corresponding author: Martin.White@nuigalway.ie

Two exploratory moorings were deployed within two individual channels of the Gollum Channel canyon system in June 2005 as part of the EU-HERMES and PTRLI cycle 3 Marine Program. Both moorings were instrumented with a bottom current meter and turbidity sensor at a height of 10/8 m above the seabed (depth 900 m), together with an array of temperature/salinity sensors at heights of 6, 18, and 64 m. Only one mooring was recovered in May 2006 and the reason for the loss of the other mooring was not determined. The recovered mooring showed significant evidence for bio-fouling from the extended stay in the canyon with a lot of hydroid growth apparent. Current meter data was significantly affected after 6 months (Christmas 2005) and the turbidity sensor provided good data for only the 1st 6 weeks of the deployment period.

A CTD profile made in June 2005 and subsequent T-S measurements from the mooring indicated the presence of Mediterranean Outflow Water (MOW) at the mooring site, typical for a depth of 900 m. The open shelf outside the canyon channel was 600 m deep, however, which suggested that the MOW had entered the canyon from the adjacent open water. Currents were tidally dominated at the principal semi-diurnal period and no amplification of diurnal currents was apparent. Some spring-neap variability in the daily mean current time-series indicated that tidal forcing of the mean was apparent, if somewhat weak. Both the residual and tidal currents were aligned along the canyon axis, i.e. across the main continental slope. Currents speeds reached a maximum of 50 cm/s but exceeded 30 cm/s for only 12% of the measurement period. Turbidity values showed a tidally dominated variability and maximum values at spring tides. Correlation with the current data indicated a mean (Eulerian measured) down-slope flux of the suspended material in the canyon channel.

# Appendix 1 - Open Discussion / Feedback session

The objective of the open discussion / feedback session was provide a forum for delegates to discuss issues relating to habitat mapping in the sub-tidal zone. Mike Cunningham (MCA) opened the discussion by asking the questions"why do we map?" and "what are the maps for?" A discussion followed with input from Phil Weaver (NOC) highlighting the importance of habitat mapping to understand the habitats on the seafloor and produce habitat maps to direct legislation and avoid exploitation of marine resources. Habitat maps provide a mechanism to advise legislators and make recommendations. Neil Golding (JNCC) highlighted the importance of mapping to develop classification schemes and questioned if enough was been done in this area. Fiona Fitzpatrick (MI) suggested the importance of agreeing on a standard termininology to describe habitats. Dave Long (BGS) commented on identifying the end-user and potential new users (e.g. marine energy) of habitat maps and the importance of adapting maps for specific purposes.

The discussion moved on to discuss the approaches to habitat mapping e.g. Karine Olu (IFREMER) commented on the bottom-up approach to habitat mapping using the geomorphological data as a first step to identifying habitats. Andy Wheeler (UCC) introduced the subject of data resolution and scale and the need for deep-tow equipment in deep waters to achieve better data resolution. Andy used the example of the TOBI data acquired in deep water, which was instrumental in identifying key habitats in previous surveys and suggested concentrating high-resolution data acquisition in key areas and following up with multibeam echosounder acquisition.

Fiona Fitzpatrick brought the topic of predictive mapping to the discussion, commenting that mapping the entire offshore area is challenging. Fiona also stressed the importance of focusing mapping in other areas besides "hotspots". Kerry Howell (University of Plymouth) highlighted the subject of mapping at broad –scale and fine-scale. Phil Weaver commented that the European Union (EU) have not categorically defined the type of habitat maps required. However, mapping projects (such as MESH) have a role to play in providing recommendations to the EU on how this may be best achieved. The EU Marine Strategy looks at mapping versus monitoring. Phil highlighted the fact that the current level if biological detail in the deep sea is small (just 10 % of biology identified to species level). Kerry Howell commented that designation of Marine Protected Areas (MPAs) required accurate maps and the time-scale involved for implementation relies on the policy-makers and not the scientists. Micheal O' Cinneide (MI) referred to the EU Marine Strategy and suggested making formal recommendations consistent with the findings of the current MESH project.

Anthony Grehan (NUI Galway) emphasised the earlier comment made of developing a standard approach to mapping in Europe. It is important to agree on terminology and apply this to classification. Andy Wheeler discussed predictive mapping referring to the HABMAP project in the Irish Sea. With 10% of data required to define the habitat – Andy questioned how reliable the models are? The importance of water column properties and nutrient fluxes was highlighted. The discussion closed with comments from Phil Weaver on broad-scale mapping in the deep sea and what the drivers are for such mapping.

# Appendix 2– Delegates List

| Firstname | Surname | Organisation | Country | Email |
|---|---|---|---|---|
| David | van Rooij | University of Ghent | Belgium | David.VanRooij@Ugent.be |
| Jean-Francois | Bourillet | IFREMER | FRANCE | Jean.Francois.Bourillet@ifremer.fr |
| Karine | Olu | IFREMER | FRANCE | kolu@ifremer.fr |
| Andy | Wheeler | University College Cork | IRELAND | a.wheeler@ucc.ie |
| Anthony | Grehan | EOS, National University of Ireland, Galway | IRELAND | anthony.grehan@nuigalway.ie |
| Boris | Dorschel | University College Cork | IRELAND | b.dorschel@ucc.ie |
| Camille | Vogel | Marine Institute | IRELAND | camille.vogel@marine.ie |
| Ciaran | O' Donnell | Marine Institute | IRELAND | ciaran.odonnell@marine.ie |
| Colin | Brown | EOS, National University of Ireland, Galway | IRELAND | colin.brown@nuigalway.ie |
| Dan | Toal | MMRRC, University of Limerick | IRELAND | daniel.toal@ul.ie |
| Deirdre | O' Driscoll | Marine Institute | IRELAND | deirdre.odriscoll@marine.ie |
| Edin | Omerdic | MMRRC, University of Limerick | IRELAND | edin.omerdic@ul.ie |
| Fabio | Sacchetti | Marine Institute | IRELAND | fabio.sacchetti@marine.ie |
| Fergal | McGrath | Marine Institute | IRELAND | fergal.mcgrath@marine.ie |
| Fiona | Fitzpatrick | Marine Institute | IRELAND | fiona.fitzpatrick@marine.ie |
| James | Riordan | MMRRC, University of Limerick | IRELAND | james.riordan@ul.ie |
| Janine | Guinan | Marine Institute | IRELAND | janine.guinan@marine.ie |
| Jonathan | White | Marine Institute | IRELAND | jonathan.white@marine.ie |
| Martin | White | EOS, National University of Ireland, Galway | IRELAND | martin.white@nuigalway.ie |
| Micheal | O Cinneide | Marine Institute | IRELAND | micheal.ocinneide@marine.ie |
| Padraic | MacAodha | IMAR | IRELAND | pmacaodha@gmail.com |
| Pauline | Ni Fhlatharta | Marine Institute | IRELAND | pauline.flaherty@marine.ie |
| Sara | Benetti | Marine Institute | IRELAND | sara.benetti@marine.ie |
| Tomás | Thompson | Marine Institute | IRELAND | thomas.thompson@marine.ie |
| Tommy | Furey | Marine Institute | IRELAND | thomas.furey@marine.ie |
| Dave | Long | British Geological Survey | UK | dal@bgs.ac.uk |
| Dave | Smith | British Geological Survey | UK | djsm@bgs.ac.uk |
| Heather | Stewart | British Geological Survey | UK | hast@bgs.ac.uk |
| Jamie | Davies | University of Plymouth | UK | jamie.davies@plymouth.ac.uk |
| Kerry | Howell | University of Plymouth | UK | kerry.howell@plymouth.ac.uk |
| Luke | | National Oceanographic Centre, Southampton | UK | |
| Mike | Cunningham | Maritime and Coastguard Agency | UK | Michael.Cunningham@mcga.gov.uk |
| Natalie | Coltman | Joint Nature Conservation Committee | UK | Natalie.Coltman@jncc.gov.uk |
| Neil | Golding | Joint Nature Conservation Committee | UK | Neil.Golding@jncc.gov.uk |
| Phil | Weaver | National Oceanographic Centre, Southampton | UK | ppew@noc.soton.ac.uk |
| Viv | Blyth-Skyrme | Joint Nature Conservation Committee | UK | Viv.Blyth-Skyrme@jncc.gov.uk |

# Appendix 3 – Workshop Programme

Day 1 Tuesday 30th January

| | | |
|---|---|---|
| 0930 – 1000 | Registration & Coffee | |
| 1000 – 1015 | Hosts Welcome | Janine Guinan, Marine Institute |
| 1015 – 1030 | Workshop Introduction | Fiona Fitzpatrick, Marine Institute |
| | **SESSION 1: Case study examples from European continental margin** | *Chair: Andy Wheeler, University College Cork* |
| 1030 – 1050 | Active along- and down slope processes on the Continental Margin of North Bay of Biscay to Goban Spur. | Mike Cunningham, Maritime and Coastguard Agency |
| 1050 – 1110 | Preliminary hydrographic results from the Gollum Channel | Martin White, National University of Ireland, Galway |
| 1110 – 1145 | **Tea / Coffee Break** | |
| | **SESSION 2: Geophysical surveying in deep water** | *Chair: Tommy Furey, Marine Institute* |
| 1145 – 1205 | Seismic profiling in deep water | Dave Long, British Geological Survey |
| 1205 – 1225 | From the far to the near-data integration and resolution: lessons from deep-water surveys | Andy Wheeler, University College Cork |
| 1225 – 1245 | Multi-disciplinary deep-water sedimentary research on channels and canyons south of the British Isles | David van Rooij, University of Ghent, |
| 1305 – 1415 | **Lunch** | |
| | **SESSION 3: Using Remotely Operated Vehicles (ROV) for deep water surveys** | *Chair: Fergal Mc Grath, Marine Institute* |
| 1415 – 1435 | Challenges of ROV system integration for deep water habitat mapping | Dan Toal, University of Limerick |
| 1435 – 1455 | The use of ROVs for offshore benthic surveys in Irish waters | Anthony Grehan, National University of Ireland, Galway |
| 1455 – 1515 | An integrated approach to ROV surveys: mapping and modelling benthic habitat using ROV-based multibeam and video datasets | Janine Guinan, Marine Institute |
| 1515 – 1535 | **Tea / Coffee Break** | |

## Day 1 (cont.) - Tuesday 30th January 2007

| | **SESSION 4: Biological investigations in deep water** | *Chair: Neil Golding, Joint Nature Conservation Committee* |
|---|---|---|
| 1535 – 1555 | Survey of deep-sea features NW of Scotland; the SEA/SAC surveys and what we have learned from them | Kerry Howell, University of Plymouth |
| 1555 – 1615 | Mapping and sampling strategies for the study of deep benthic ecosystems using ROVs – examples from coral reefs and cold seeps | Karine Olu, IFREMER |
| 1615 – 1635 | Deep marine sampling: strategies, devices and techniques - an overview | Boris Dorschel, University College Cork |
| 1930 | **Workshop Dinner** | **Kirwans Lane Restaurant, City Centre** |

## Day 2 – Wednesday 31st January 2007

| | **SESSION 5: Case study examples from European continental margin** | *Chair: Janine Guinan, Marine Institute* |
|---|---|---|
| 0930-1000 | Research on canyons within the HERMES (**H**otspot **E**cosystem **R**esearch on the **M**argins of **E**uropean **S**eas) Integrated Project | Phil Weaver, National Oceanographic Centre, Southampton |
| 1000-1020 | Geomorphological overview of submarine canyons in the Northern Bay of Biscay Margin | Jean-Francois Bourillet, IFREMER |
| 1020-1040 | Habitat classification – an overview of current classification schemes | Fiona Fitzpatrick, Marine Institute |
| 1040-1115 | **Tea / Coffee Break** | |
| 1115-1245 | Open Discussion /Attendee Feedback Session | *Facilitator – Micheal O'Cinneide, Marine Institute* |
| 1245-1400 | **Lunch** | |
| 1400 – 1515 | Canyon cruise planning meeting I | Open to MESH partners & cruise participants |
| 1515 – 1530 | **Tea/Coffee Break** | |
| 1530 – 1700 | Canyon cruise planning meeting | MESH partners & cruise participants |
| | | |

# Appendix 4 – Literature cited

Beyer, A., Schenke, H.W., Klenke, M. and Niederjasper, F., 2003. High resolution bathymetry of the eastern slope of the Porcupine Seabight. Marine Geology, 198: 27-54.

De Mol, B., Van Rensbergen, P., Pillen, S., Van Herreweghe, K., Van Rooij, D., McDonnell, A., Huvenne, V., Ivanov, M., Swennen, R. and Henriet, J.-P., 2002. Large deep-water coral banks in the Porcupine Basin, southwest of Ireland. Marine Geology, 188: 193-231.

EUNIS, 2004. EUNIS habitat classification revised

Greene, H.G., Yoklavich, M.M., Starr, R.M., O'Connell, V.M., Wakefield, W.W., Sullivan, D.E., McRea, J., James E. and Cailliet, G.M., 1999. A classification scheme for deep seafloor habitats. Oceanologica Acta, 22(6): 663-678.

Roff, J.C. and Taylor, M.E., 2000. A geophysical classification system for marine conservation. Journal of Aquatic Conservation: Marine and Freshwater Ecosystems, 10: 209-233.

Roff, J.C., Taylor, M.E. and Laughren, J., 2003. Geophysical approaches to the classification, delineation and monitoring of marine habitats and their communities. Aquatic Conservation: Marine and Freshwater Ecosystems., 13: 77-90.

Scientists, I.E., 2005. Modern carbonate mounds: Porcupine drilling, IODP Prel. Rept.

Vincent, M.A., Atkins, S., Lumb, C., Golding, N., Lieberknecht, L.M. and Webster, M., 2004. Marine nature conservation and sustainable development: the Irish Sea Pilot. JNCC and online at www.jncc.gov.uk/irishseapilot.

Wheeler, A.J., Kenyon, N.H., Ivanov, M.K., Beyer, A., Cronin, B., McDonnell, A., Schenke, H.W., Akhmetzhanov, A.M., Satur, N. and Zaragosi, S., 2003. Canyon Heads and Channel Architecture of the Gollum Channel, Porcupine Seabight. In: J. Mienert and P.P.E. Weaver (Editors), European margin sediment dynamics: side-scan sonar and seismic images. Springer-Verlag, Heidelberg, pp. 183-186.