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Report of the Working Group on Marine Habitat Mapping (WGMHM)

30 March–2 April 2004
Brest, France

International Council for the Exploration of the Sea

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0 EXECUTIVE SUMMARY

The Working Group on Marine Habitat Mapping (WGMHM) convened in France from 30 March-2 April 2004 at the IFREMER Institute, Brest. The meeting was chaired by David Connor (UK) and attended by 37 people, from Belgium, Canada, Denmark, France, Germany, Ireland, Norway, Poland, Spain, Sweden, the Netherlands and the UK.

National habitat mapping programmes - The review of national status reports revealed a broad spectrum of activities across the ICES countries, from broad-scale national programmes through to series of unconnected small-area studies. Some countries had national mapping strategies in place and several were trying to establish them. Ireland is the only ICES country which has a national mapping programme designed to map its entire EEZ using high quality modern techniques. France has an alternative national strategy, where the REBENT programme has collated existing data sets into a GIS and is now supplementing these with a coordinated programme of high quality new studies, primarily focused on inshore waters.

International habitat mapping initiatives

North-west Europe - The three-year Interreg-funded project MESH (www.jncc.gov.uk/MESH), which aims to establish a framework for mapping habitats within European waters, was introduced. A major programme to collate existing data will be undertaken, and the data harmonised to common classification schemes (EUNIS, EC Habitats Directive) to present maps for north-west Europe. Predictive modelling techniques will be developed and confidence levels associated with the maps produced. The programme will review and develop international standards and protocols for mapping seabed habitats, including both remote-sensing and ground-truthing techniques.

North Sea - WGMHM 2003 initiated work to generate a prototype habitat map of the North Sea and had accessed initial datasets. The strategies demonstrated for the North Sea (by NIVA for the EEA) and for the Irish Sea (marine landscapes by JNCC) offered alternative models for the use of existing data sets and aimed at broad-scale characterisation of large sea areas. Both approaches use available geophysical and hydrographic data sets which are integrated in a GIS. The NIVA model adopts a top-down approach using an *a priori* classification of habitat types (the EUNIS classification), whilst the Irish Sea model uses a bottom-up approach to derive a classification (marine landscape types) based on the data available. The type of data needed for the North Sea and its likely availability was assessed. Members would access further data sets over the coming year, ensuring minimal overlap of effort between NIVA (for the EEA's EUNIS mapping task) and the MESH project.

Baltic Sea - WGMHM discussed the HELCOM request on marine habitat mapping following an introductory perspective by the Chair of SGEH. The approaches being adopted for the North Sea and MESH projects offered useful models for how to proceed in the Baltic. WGMHM offered its expertise to assist SGEH, and Baltic participation in WGMHM was encouraged.

North-east Atlantic (OSPAR) - An update to the marine elements of the EEA's EUNIS habitat classification system relating to the north-east Atlantic had recently been completed for OSPAR's Biodiversity Committee. The revision represents a significant advance of the EUNIS system and now requires extensive testing and evaluation, particularly through mapping programmes such as MESH. A programme for mapping 14 OSPAR priority habitats had recently started; it would collate point-location data to compile distribution maps for each habitat type by 2005.

Development of guidelines for habitat mapping - WGMHM 2003 concluded that there were many techniques being used by different workers, only some of which had well-developed standards for their operation. Additionally the overall strategy for mapping and the types of interpretation and presentation varied considerably, leading to considerable difficulties in integrating data from different sources. There was, therefore, an urgent need to capture best practice in habitat mapping studies so that data were of high quality and to improve compatibility between studies.

The MESH project will draw together best practice on data standards and methodological protocols, together with guidance on mapping strategies, to provide such a common framework. The work will cover both intertidal (e.g., aerial photography, Lidar, Casi) and subtidal (e.g., multibeam, sidescan, AGDS) techniques and associated ground-truthing methods (e.g., field surveying, grabs, video). Because of the importance of such guidelines to the ICES community, and level of the expertise within this and other ICES Working Groups, it was recommended that there should be active involvement from ICES in developing these guidelines. Initial discussion centred on development of metadata standards for mapping techniques and for habitat maps.

Intercalibration and quality control of mapping techniques - WGMHM discussed the outcomes of a workshop examining quality control issues in the use of RoxAnn single beam acoustic techniques. It was concluded that RoxAnn provides complimentary data to swathe systems and is best used in combination with other acoustic techniques rather than on its own (with appropriate ground-truthing). More generic issues were raised about confidence in habitat types and boundaries shown on final maps, which are equally relevant to other techniques. Methods should be developed to present levels of confidence in the maps.

Inconsistencies in the interpretation of acoustic and ground-truth data result in habitat maps which are difficult to edge-match maps from different studies. Where maps are derived from different techniques, there is less likelihood of good edge-matching. Addressing these issues requires: improved protocols for processing each data type to reduce inter-worker variability, further intercalibration exercises between workers to improve QA/QC, further testing and development of standard habitat classification schemes, including linking between local mapping data and national/international schemes.

Advantages and constraints of habitat mapping in a management context - WGMHM reviewed several uses of habitat mapping for specific management issues, including aggregate dredging and nature conservation. The use of swathe systems should be the preferred approach in monitoring and assessment studies. The generation of a geomorphological map, to which other data sets are appended, provides an essential level of information necessary to fully understand the nature of the study site and the relationship of any human impact on it. Swathe techniques have repeatedly proven to give quantitative results in industrial applications, such as dredging and dumping.

1 OPENING OF MEETING

The Working Group on Marine Habitat Mapping (WGMHM) convened in France from 30 March-2 April 2004 at the IFREMER Institute (Institut Français de Recherche pour l'Exploitation de la Mer), Brest. Yann Hervé De Roeck (Head of the operational applications service in IFREMER's Environment Division) opened the meeting on behalf of the IFREMER Brest Centre's Director, G. Riou, and the Environment Division's Director, B. Barnouin. He provided an overview of the work of IFREMER and wished the Group every success in its work.

The meeting was chaired by David Connor (UK) and hosted by Brigitte Guillaumont, with the financial support of IFREMER and the Brittany Region. It was attended by 37 people, from Belgium, Canada, Denmark, France, Germany, Ireland, Norway, Poland, Spain, Sweden, the Netherlands and the UK (Annex 1), each providing a brief introduction of themselves. Apologies were received from: Becky Allee (USA), Pascal Boudreau (Canada), Ingeborg de Boois (Netherlands), Stig Helmig (Denmark), Eric Jagtman (Netherlands), Peter Lawton (Canada), Thomas Noji (USA), Mike Robertson (UK), Yolanda Sagarminga (Spain), Matthew Service (UK), Megan Tyrrell (USA), Page Valentine (USA), and Jan van Dalfsen (Netherlands).

1.1 Appointment of Rapporteurs

The task of preparing the report of the meeting was shared amongst participants as follows: Craig Brown (item 3), Dave Limpenny and Brian Todd (item 5), Roger Coggan (items 4 and 10), Fiona Fitzpatrick (items 6, 7 and 9), Eugene Andrulewicz (item 8), Annika Mitchell (item 6), with additional contributions from individuals who made presentations.

1.2 Terms of Reference

The Terms of Reference for the meeting were noted and are given in Annex 2. The Agenda and this report were specifically structured to address each item on the ToR.

2 ADOPTION OF AGENDA

The previously distributed draft Agenda for the meeting was discussed, adding several additional national status reports and adjusting the timetabling to suit the availability of certain participants. The adopted Agenda is given in Annex 3.

3 PRESENTATION AND REVIEW OF NATIONAL STATUS REPORTS ON HABITAT MAPPING AND CLASSIFICATION ACTIVITIES ACCORDING TO THE STANDARD REPORTING FORMAT (TOR B)

WGMHM discussed the National Status Reports after presentations from national representatives in the Working Group. Annex 4 provides a compilation of the National Status Reports submitted to the meeting, according to the standard format agreed at the 2002 WGMHM meeting.

3.1 Canada

Brian Todd presented an overview of a mapping study on German Bank, off southern Nova Scotia. The studies in Canada are commonly cross-disciplinary, involving geologists, biologists and oceanographers. Surveys on German Bank cover an area of approximately 5300 km^2 and have utilised a range of acoustic and ground-truthing techniques (e.g.,, multibeam sonar, seismic, sidescan sonar and underwater video). Maps are produced of bathymetry, backscatter, surficial geology and benthic habitat. A newly developed habitat classification scheme is now in use: NE North American Marine Sublittoral Habitat Classification (see Annex 5).

Vladimir Kostylev provided an overview of other mapping programmes underway in Canada in the Gulf of Maine, on the Scotian Shelf, on the Pacific coast of Canada and around the coast of Nova Scotia. These projects have adopted similar approaches to that presented above for German Bank. Work led by DFO (Department of Fisheries and Oceans), is also utilising QTC (Quester Tangent Corporation) to assist in the identification of habitats. Work on the west coast of Canada is attempting to map deep-water sponge habitats.

3.2 UK

Craig Brown presented a brief overview of activities in the UK. Of the 147 seabed mapping studies reported in the 2003 Status Report (covering a period of about 10 years), six are still ongoing. Seven new entries are included for 2004, a number of which were presented in more detail during the course of the meeting. The UK still has no national strategy for seabed mapping, with studies tending to cover small areas only and using a variety of techniques.

David Connor introduced the Interreg-funded MESH (Mapping European Seabed Habitats) project (Annex 6, www.jncc.gov.uk/MESH). The programme aims to establish a framework for mapping habitats within European waters. The project will involve 12 partners from Ireland, UK, Belgium, the Netherlands, and France and will run for three years starting in spring 2004. An overview of the main objectives was presented. A major programme to collate existing data will be undertaken, and the data harmonised to common classification schemes (EUNIS, EC Habitats Directive). Predictive modelling techniques will be developed and applied to predict likely habitats in areas where data coverage is poor. Confidence levels will be associated with the maps which are produced. The programme will also review and develop international standards and protocols for mapping seabed habitats, including both remote-sensing and ground-truthing techniques (see Agenda item 4). New field surveys will be undertaken to test these protocols and standards. The programme will demonstrate a range of applications of mapping data and will involve the end users of habitat maps, focusing on communication and dissemination of the findings. The programme will ultimately aim to develop a framework for future seabed mapping. WGMHM would be kept closely involved with future developments within the project.

3.3 France

Brigitte Guillaumont presented mapping activities underway in France. A number of existing data sets have been collated. Bathymetric data is derived from navigation charts and from echo sounder records. These have been integrated into a database. Lidar is also being used to collect bathymetric data from tidal areas. A mosaic of aerial photographs has been compiled for most of the coastline of France. Acoustic surveys are underway in certain areas around the French coastline. Benthic surveys to characterise seabed communities have been digitised into a GIS which collates multiple data sets. There are new projects underway to produce high resolution habitat maps (**REBENT** project) using a variety of techniques from satellite imagery through to acoustic surveys (see Annex 7). A newly launched interactive GIS web site for the REBENT programme was demonstrated (www.ifremer.fr/rebent); it provides a range of broad-scale and fine-scale maps, and includes a facility to download data.

Eric Moussat presented the work of **SISMER** which is the designated National Oceanographic Data Centre for France (French NODC), based at IFREMER Brest. The centre is involved in the collation and storage of a wide range of data sets and data types. An overview of the data management systems which are used was presented. A large number of data sets are held within the data banks, including geophysical data sets. A number of these data banks were described (e.g., Euroseismic project dealing with seismic lines around Europe; Geological data bank). The facility can handle very large volumes of data. Further information relating to the activities of SISMER can be found at www.ifremer.fr/sismer.

Jacques Populus, Axel Erhold and Claire Rollet (IFREMER) presented the work of the REBENT project in habitat mapping of tidal areas (using orthophotographs, spot imagery, lidar and *in situ* measurements) and sub-tidal areas (using multibeam, sidescan, video and sampling). This addressed habitat mapping of the Brittany coast, working on three spatial scales; a broad coverage of the entire area, an intermediate scale focusing on 20 nominated ‘sectors’ (each approx 50 km^2) incorporating Natura 2000 sites, and small area (large-scale) site-specific surveys covered by ‘spot’ sampling. At each of these spatial scales, the selection of appropriate mapping technologies was driven by the water depth and the target fauna. Specific examples of studies in tidal and subtidal areas were presented. GIS had been extensively used to construct and present habitat maps and the use of fuzzy logic was being explored as a method for mapping areas without bounding them in distinct polygons. There followed an informative discussion on approaches to ground-truthing the various remote technologies used by the REBENT project, and the advantages of maintaining a multidisciplinary team throughout the mapping process (rather than each discipline working largely in isolation).

3.4 Belgium

Vera Van Lancker presented an overview of mapping activities in Belgium. Results were presented from joint biology/geology HABITAT projects. These revealed a good level of predictability of benthic communities based on very-high resolution sidescan sonar imagery. The richest benthic community has been directly visualised on the imagery, whilst other communities are predicted from a correlation with sediment characteristics. Acoustic facies-modelling has been used to link the acoustic and biological properties of the seabed. The findings were further validated along the coast and in ongoing work in the offshore areas in the framework of the **Marebasse** project. A variety of techniques (multibeam, sidescan sonar, AGDS, grabs, box coring, and video techniques) is being used to test their intercompatibility and their suitability for habitat mapping. Problems are especially encountered in the mud-dominated areas where only a poor correlation is found between acoustic seabed classification and sediment characteristics and hence habitat properties. Finally, a GIS-based zonation approach was outlined as a basis of a predictive modelling tool for habitat mapping.

3.5 Denmark

Jørgen Leth and Johnny Reker presented the National Status Report for Denmark. Denmark has no national mapping strategy for marine habitats at present. Mapping activities in the North Sea have traditionally been of a geological nature or related to nautical or coastal defence interests, while mapping activities with a biological content have had a very low profile. More information is available for the Inner Danish waters, though at present there is no overview of available datasets.

Recent mapping activities in the North Sea include a satellite tracking project of Harbour Porpoise in Danish waters and surrounding seas. Other initiatives include mapping the geology of the seafloor along the west coast of Jutland, mainly for marine aggregates or coastal defence purposes, as well as a review of available geological data for mapping EC Habitats Directive Annex 1 habitats (sandbanks, mudflats, and reefs) in the Danish Territorial Waters. Habitat mapping of boulder reefs has been undertaken using Quester Tangent Corporation (QTC) software and multibeam sonar. Ongoing activities include the national monitoring programme **NOVANA** from which habitat maps of, for example *Zostera marina* seagrass beds, can be produced. Annual surveys of mussel beds are done by DIFRES (Danish Institute for Fisheries Research). For the Baltic Sea, the **CHARM** project (Characterisation of the Baltic Sea Ecosystems; dynamics and function of coastal types) has wide participation from the Baltic nations. The project is developing a typology for the Baltic Sea ecoregion for the EC Water Framework Directive, on the basis of hydrographic and biological variables.

In March 2004 there was a new initiative to hold a marine habitat mapping workshop, with participation from a wide range of national stakeholders and the aim of forming a national marine habitat mapping working group. The intention is that the working group will formulate a national strategy for mapping marine habitats in Denmark. This will be done in order to co-ordinate national mapping effort, to establish a national network of stakeholders, to co-ordinate Danish participation in international activities and to create an overview of existing projects and available data and thereby identify future needs.

3.6 Baltic Sea

Eugene Andrulewicz, representing the Baltic Sea Regional Programme and as Chair of the ICES Study Group on Baltic Sea Ecosystem Health Issues (SGEH), provided an overview for the Baltic Sea region. There are many anthropogenic activities in the Baltic Sea which lead to a need for marine benthic habitat maps to assist in environmental management issues. However the present status of mapping in the Baltic has not been fully assessed and there is a need to coordinate work from all countries bordering the Baltic to progress with classification and mapping of habitats. The development of a habitat classification and mapping programme for the Baltic is being actively considered (see Agenda Item 8).

3.7 Ireland

Fiona Fitzpatrick and Anthony Grehan presented the National Status Report for Ireland (Annex 8).

In 2003, four mapping initiatives were carried out within Irish waters, namely the continuation of the Irish National Seabed Survey, the mapping of trawl sites used for ground-fish stock assessment, the mapping of scallop beds, and the collection of ground-truth samples and ROV video footage around deep-water corals in the Porcupine Bank region of the Irish EEZ. Additionally, the Irish inshore mapping strategy was completed and key areas targeted for integrated mapping initiatives.

3.7.1 Irish National Seabed Survey

The Irish EEZ is divided into three bathymetric zones and current effort is concentrated in Zone 2, between the 50 and 200m isobaths and key areas of Zone 1, between the shore and the 50-m isobath. Zone 2 operations, offshore Northern Donegal (c.9700 km^2), were carried out between May and September 2003, employing the R.V. Celtic Explorer as the survey platform. Zone 1 mapping was carried out from the R.V. Celtic Voyager, during November and December 2003 and the survey area concentrated in the Greater Dublin Bay area (201 km^2).

3.7.2 Groundfish stock assessment

The Irish groundfish assessment survey constitutes three two-week surveys contributing to the annual survey programme carried out by EU ICES member states. The main purpose of the survey is to provide abundance indices for juveniles of commercially important target species, through benthic trawling of previous and newly acquired sites and the categorising, weighing and ageing of the catch. The results of which, when coupled together with other results from adjacent and previous surveys, are compiled to create an indication of the state and sustainability of these target species and the fisheries they inhabit. The target species concerned are haddock, whiting, megrim, plaice, cod, hake, monkfish, sole, John Dory, mackerel, herring, scad, and sprat. As the fisheries operations are limited to daylight hours only, multibeam and echo sounder data were collected during the night; identifying safe new trawl sites and checking commercial trawl locations for obstructions. In addition to providing the ground-fish scientists with information on the type of the seafloor, enabling an informed decision on the type of net to be deployed, the data gathered can be fed directly into the national data base.

3.7.3 Stock assessment of scallops on the south coast of Ireland 2001–2004

The Coastal and Marine Resources Centre (CMRC), in conjunction with the Irish Sea Fisheries Board, Trinity College Dublin, the Marine Institute and the Geological Survey of Ireland are carrying out a multibeam sonar mapping and scallop stock assessment employing GIS data integration in support of sustainable fisheries management. The research is being undertaken as a principal component in a multidisciplinary approach to the development of a strategic plan for the management of scallop *Pecten maximus* stocks off the south-east coast of Ireland. A series of GIS tools are used in conjunction with a geodatabase in order to assist in evaluating the relationship between seabed sediment type and scallop stock density. Geophysical data layers including multibeam sonar maps (MBES bathymetry, morphology and acoustic backscatter) and other seabed data layers (sediment samples, sub-sea video imagery, statistical sediment classifications) are overlain and analysed in combination with layers of quantitative biological data showing scallop catch rates.

3.7.4 Polarstern ARK XIX/3a

A joint Alfred Wegener Institut (AWI) and IFREMER international research cruise was undertaken aboard the German ice-breaker RV Polarstern in June 2003. Detailed mapping of a number of carbonate mounds and deep-water coral targets off the west coast was undertaken using the IFREMER research ROV ‘VICTOR 6000’. Researchers from several European countries including Germany, the United Kingdom, Belgium, France and Ireland also participated. More than 100 hours of video were recorded during nine dives, which covered over 100 km of seafloor in the Porcupine Seabight and on the western slope of the Porcupine Bank. When combined with previous work carried out during an earlier IFREMER-organized cruise (CARACOLE) with VICTOR in 2001, these surveys will enable the production of the most detailed deep-water habitat maps available to date.

3.7.5 Inshore mapping strategy

The Marine Institute in conjunction with the relevant stakeholders are presently finalising a strategy document for integrated inshore surveys in Ireland. The strategy has identified key areas and methods of survey. The bays and estuaries along the Irish coast targeted as loci for sea-floor mapping have been identified in consultation with the various users and stakeholders. The identified bays and estuaries were then examined individually and their relative importance assessed in terms of their relevance to shipping routes, fisheries, Natura 2000 status, archaeological status, etc. The bays were grouped and graded and the final selection returned to stakeholders for peer review. Priority-mapping requirements have been spilt into priority bays and priority areas. Prioritising bays and areas of strategic importance were compiled with respect to multi-user requirements (which involved an assessment of stakeholders’ requirements).

The intended plans for 2004 include the continued mapping for the INSS (Irish National Seabed Survey) with 135 days on the R.V. Celtic Explorer and 55 days on the R.V. Celtic Voyager, expansion of the groundfish and pelagic fish stock assessment programmes and participation in the Interreg MESH (Mapping European Seabed Habitats) project.

3.8 Netherlands

Norbert Dankers outlined a number of activities taking place in the Netherlands, noting that mapping effort in the Netherlands needed better coordination. There were a variety of fine-scale studies in intertidal areas and the Wadden Sea. Of particular note was the recent surge in distribution and abundance of Pacific oyster *Crassostrea gigas* (a non-native species) in intertidal areas. Although present in previous years, last year saw significant increases in densities to the extent that they now form biogenic reefs (shells concreted together) and appear to be out-competing *Mytilus edulis* on existing mussel beds.

3.9 Spain

Ibon Galparsoro indicated that the Spanish Oceanographic Institute (IEO) is carrying out an integrated seafloor cartography programme for the entire Spanish continental shelf. For the Basque continental shelf, AZTI Foundation is going to collaborate in this campaign, data analysis and interpretation. The work on the Basque coast will take three months, starting in May 2004. The techniques to be used will be multibeam, high resolution seismic system (TOPAS), ground sampling and samples from divers.

The map series to be produced will comprise:

- Series A: Bathymetry and seafloor characteristics;
- Series B: Management and uses;
- Series C: Digital models and geomorphology.

3.10 Norway

John Alvsvåg provided a report of habitat mapping projects in Norway for 2003 (Annex 9). As for the 2002 report the response from Norwegian research institutions had been low, and only 7 projects where added to the table. In four of these projects the Institute of Marine Research are involved, whilst the Norwegian Institute of Water Research are responsible for the remainder.

3.11 USA

Thomas Noji, who was unable to attend the meeting, provided a summary of a major new initiative for the USA – an Integrated Ocean Mapping programme (Annex 10).

3.12 Discussion

The review of national status reports revealed a broad spectrum of activities across the ICES countries, from broad-scale national programmes through to series of unconnected small-area studies. Some countries had national mapping strategies in place and several were trying to establish them. It was noted that Ireland is the only ICES country which has a national mapping programme underway that is designed to map its entire EEZ using high quality modern techniques. The Irish National Seabed Survey was considered to be an excellent example of what can be achieved if funding is made available. An alternative national strategy is found in France, where the REBENT programme has collated existing data sets into a GIS and is now supplementing these with a coordinated programme of high quality new studies, primarily focused on inshore waters.

It was noted that the adoption of a national mapping programme can depend on the funding routes at a government level within each country. In Ireland funding needed only to be sought from one government department, whilst Canada relied on just two departments. In countries where funding responsibilities rest with more departments it appears to be more difficult to identify and secure funding for such initiatives.

The number of countries seeking to develop national mapping strategies was encouraging whilst the forthcoming MESH project for North-West Europe should provide a much needed foundation for integration of mapping data at a multinational scale.

The following were noted as areas that could provide significant opportunities to develop or encourage broad-scale or multinational mapping initiatives:

- Fisheries;
- EU Marine Strategy;
- Water Framework Directive.

WGMHM considered the relevance of national mapping studies to ICES. It was felt that many of the studies presented used very similar strategies, namely a multidisciplinary approach which collects and integrates geomorphological, hydrographic and biological data through the use of a GIS. The resulting data sets and habitat maps could be useful from a fisheries perspective for ICES in an ecosystem approach to management.

For the Water Framework Directive (WFD) it was recognised that setting reference conditions against which to assess quality of coastal and transitional (estuarine) waters will prove challenging. There has been a recent move to use habitat classifications (e.g., EUNIS) as a feasible tool to help define reference conditions for each water body type, because such reference types needed to be defined at the habitat scale rather than at the water body scale. WGMHM considered that extending this to the production of habitat maps could have significant long-term benefits for practical delivery of WFD monitoring and assessment needs. In particular use of habitat distribution maps would enable a stratified approach to monitoring to be developed, and would provide a broader context for monitoring data than traditional spot sampling strategies. The WFD was thus one possible driver to assist in securing funding for mapping activities.

A frequent problem with mapping programmes appears to be a gap in coverage for inshore areas, as larger survey vessels cannot survey in shallow water and coastal/intertidal studies typically stop at low water. Visible remote sensing (lidar, Casi, digitized aerial photographies) currently achieve the mapping of the tidal zone, but the capabilities of such remote sensing in filling up this gap remains to be assessed. Through use of airborne remote sensing techniques (e.g., Casi, Lidar) IFREMER are successfully filling these gaps to map shallow water areas.

A number of major studies were underway or being started which could contribute to broader international perspectives. However, these studies could be more compatible if the scale and the dimensions of the planned cartographic outputs were standardised to the already accepted pan-European ICES charting system.

4 FURTHER PROGRESS ON THE DEVELOPMENT OF GUIDELINES FOR HABITAT MAPPING (TOR E)

WGMHM 2003 had initiated a discussion on the need for and availability of guidelines for habitat mapping. It had concluded that there were many techniques being used by different workers, only some of which had well-developed standards for their operation. Additionally the overall strategy for mapping and the types of interpretation and presentation varied considerably, leading to considerable difficulties in integrating data from different sources. There was, therefore, an urgent need to capture best practice in habitat mapping studies so that data were of high quality and to improve compatibility between studies.

4.1 MESH Project – development of data standards and methodological protocols

Roger Coggan described Action 2 from the forthcoming MESH project (Mapping European Seabed Habitats, as outlined in Agenda Item 3, Annex 6 and at http://www.jncc.gov.uk/marine/mesh/) which contained a number of work elements that would directly address this ICES term of reference. Action 2 aims to develop a set of guidelines for marine habitat mapping which will, *inter alia*, include details of data standards and methodological protocols. The intention is to provide a common framework such that future mapping initiatives can contribute directly to a unified and harmonised habitat map for NW Europe.

The possibilities of adopting standards and protocols within each step of the mapping process (data collection, processing, interpretation and presentation) will be explored. An initial review of current practice will identify areas where satisfactory standards and protocols already exist, and highlight those areas where further development is most needed. IFREMER (France) will lead on work addressing intertidal and shallow subtidal mapping, whilst CEFAS (UK) will lead on work addressing deeper subtidal habitats. Other areas that will be addressed by this work strand of the MESH project include:

- standardising the interpretation of data from individual technologies;
- exploring synergies, inter-calibration and cross-correlation between different technologies (leading to data fusion);
- examining and developing the utility of the EUNIS marine habitat classification scheme;
- developing methods for rating confidence in habitat maps; and
- developing formats to facilitate data exchange and archiving.

These elements will be brought together in a final report constituting a guidance framework for marine habitat mapping.

This development was generally welcomed by WGMHM, as the development of such guidelines within a project environment would allow a greater level of effort to be devoted to it than could be achieved by the WG. The WG provided advice on sourcing existing guidelines and the level of detail required in new standards and protocols, and suggested the need to hone and promote the product to the target audience. Because of the importance of such guidelines to the ICES community, and level of the expertise within this and other ICES Working Groups, it was recommended that there should be active involvement from ICES in developing these guidelines. It was further recommended that ICES colleagues be invited to appropriate MESH meetings and that the draft guidelines be made available to future meetings of relevant ICES groups for peer review.

It was noted that SGASC (Study Group on Acoustic Seabed Classification) at its meeting in 2003 had announced its intention to prepare a report on acoustic mapping techniques. As there was potential for duplication of effort, the MESH Action Leader (Roger Coggan) undertook to liaise with the SGASC Chair (John Anderson) to establish more clearly the nature of the intended report, with a view to further cooperation and minimizing duplication as appropriate.

4.2 Development of metadata standards for mapping techniques – an initial discussion

The need for metadata to accompany a habitat map was recognised, in order to provide information on how the map was compiled. A schematic view of the types of metadata that might be required for any habitat map was presented by David Connor and discussed. In electronic maps (e.g., GIS based) such metadata should ideally be available whilst viewing the map (allowing the metadata itself to be mapped as a queryable entity). The scheme presented was generally considered desirable, although it was recognised that not all elements would be available for every map. The scheme is presented in Annex 11 and will be further developed within the MESH project.

Discussion proceeded on what metadata fields are needed to provide an adequate level of information, bearing in mind that different users will be interested in different metadata. For example, some will require information relating to the methods used for data collection and post-processing while others will seek information on how a particular polygon was generated (e.g., by some automated means or based on expert judgement). Certain existing metadata standards were briefly reviewed and consensus sought to work towards the ISO 19115 standard for geospatial metadata.

In addition to the top level standard metadata that should be associated with any data set, it was recognised that mapping data sets additionally should capture fine-level metadata about the techniques used to collect, process and present the data. An initial draft list of such metadata fields for the various survey technologies (e.g., optical, acoustic and ground-truthing techniques) had been prepared by Neil Golding. WG members were invited to provide further advice on this matter and following discussion an updated list of metadata fields was developed (Annex 12); it too will be further developed and used within the MESH project. Metadata fields were needed for each of the main phases in the mapping process (collection, post-processing, interpretation and presentation) so that users could track its development from raw field data through to processed data or habitat maps.

5 COMMENCE DEVELOPMENT OF A GENERIC BENTHIC/PELAGIC HABITAT MAPPING FRAMEWORK FOR THE NORTH SEA AND PRODUCE A PROTOTYPE HABITAT MAP OF THE NORTH SEA THAT COULD BE USEFUL FOR THE INTERPRETATION OF THE NORTH SEA BENTHOS PROJECT (TOR A)

WGMHM 2003 had recommended that the WG generate a prototype habitat map of the North Sea, as a practical means of using the available expertise within the WG, to raise issues about the habitat mapping process that could be further discussed, and to provide information of assistance to SGNSBP (Study Group on the North Sea Benthos Project). Over the 2003-2004 winter many useful datasets were sourced to provide a starting point for this year's meeting; it was noted that no suitable habitat map for the entire North Sea was yet available.

5.1 Introduction

This item was initiated through a general introductory discussion led by Brian Todd, followed by two presentations which offered different approaches to the production of broad-scale maps based on existing data. These provided the Working Group with views on how to proceed, which were further developed by a sub-group who reported back to plenary for a final discussion.

Brian Todd introduced the session by presenting recently published maps of Browns Bank, Scotian Shelf, produced by the Geological Survey of Canada. These maps depict the topography and surficial geology of the survey area and also the acoustic backscatter and benthic habitats. Although the Browns Bank maps are at a scale of 1:100,000, a scale of

1:50,000 has been set for map production by the Geological Survey of Canada. He advocated the following process for production of maps for the North Sea:

1) Acquisition of four basic data layers:
   - Coastline
   - Topography
   - Backscatter
   - Surficial seabed sediment type

2) The establishment of a GIS project to hold the above series of data layers. Once this base map is created, critical benthic and pelagic biological information (much of which is available on-line) can be selected and geospatially located on the base map. Statistical and geospatial analysis of the biological information, in combination with the substrate and oceanographic data, is necessary to define polygons of seabed habitat. Interpretation within the GIS, mostly through expert judgment with automated procedures where applicable, would then lead to suitable habitat maps as an 'end-product' interpreted layer.

There was some initial discussion on the type of data layers required, including their format, level of accuracy and spatial coverage. It was evident that there were many different views, all of which are valid depending on the aims of each project. However, overall, to produce a thematic habitat map at a North Sea scale, the most appropriate data should, if possible:

- be processed geo-referenced data (i.e., standardized to some degree of consistent interpretation or be capable of such);
- cover the entire North Sea area;
- be in polygon, polyline or grid format to enable interrogation with the other data layers.

5.2 Holistic mapping of the potential occurrence of marine habitats in the North Sea

Kjell Magnus Norderhaug presented the approach being used to generate holistic marine habitat maps in a European Environment Agency (EEA) task being undertaken by NIVA (Norway). The overall goal is to obtain an overview of marine habitat distribution at a European level and to develop GIS means for marine habitat mapping according to the hierarchical structure of the European Nature Information System (EUNIS). Available chemical, physical, geological and biological data relevant to predict EUNIS habitats are collected and a habitat map at EUNIS level 3 of the North Sea is under production. Several limitations concerning data availability, especially in shallow water, have been identified, but it is expected that these shortcomings will be overcome in the continuation of the project in 2004. The results will be made available to other initiatives working with habitat mapping and ICES was invited to cooperate in data collecting. NIVA considered it important to coordinate efforts in order to avoid duplication of effort.

5.3 A marine landscape classification for the Irish Sea

Neil Golding described the development of a classification of marine landscape types, a project undertaken as part of the UK government's Irish Sea Pilot (Golding *et al*., 2004[1]). The concept of marine landscapes stems from Roff and Taylor (2000)[2] (using the equivalent term 'seascapes'), who advocated the use of broad-scale geophysical and hydrographic data to characterise large areas of ocean in an ecologically relevant manner. The approach is particularly well suited to areas away from the coast, where biological information is often lacking, and marine mapping programmes are costly. It enables the rapid characterisation of such areas for management of human activities and nature conservation. From the work carried out under the Irish Sea Pilot, eighteen seabed and coastal marine landscape types and four water column types were identified. These were validated against "ground-truth" biological data and were generally shown to have a good correlation with this ecological information. The Irish Sea Pilot has shown that the identification and mapping of marine landscape types at the regional sea scale is fully practical with limited resources. It produced a classification which is somewhat broader than that derived from intensive habitat mapping programmes but which is appropriate for large sea areas such as the Irish or North Sea and for certain management purposes.

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[1] Golding, N., Vincent, M.A., and Connor, D.W. 2004. Irish Sea Pilot – Report on the development of a marine landscape classification for the Irish Sea. Peterborough, Joint Nature Conservation Committee and online at www.jncc.gov.uk/IrishSeaPilot.

[2] Roff, J.C., and Taylor, M.E. 2000. Viewpoint: National frameworks for marine conservation: a hierarchical geophysical approach. Aquatic Conservation: Marine and Freshwater Ecosystems, 10: 209–223.

5.4 Discussion

5.4.1 Strategies for broad-scale mapping

Whilst WGMHM recognised that the most comprehensive and accurate maps are derived from dedicated programmes involving an integrated multi-disciplinary approach of acoustic and ground-truth sampling (e.g., the Canadian German Bank study), such programmes are costly to undertake and alternative solutions are often needed to provide holistic maps in the mean time. The strategies demonstrated for the North Sea (by NIVA) and for the Irish Sea (by JNCC) offered alternative models for the use of existing data sets and aimed at broad-scale characterisation of large sea areas. Both approaches use available geophysical and hydrographic data sets which are integrated in a GIS. The NIVA model adopts a top-down approach using an *a priori* classification of habitat types (the EUNIS classification), whilst the Irish Sea model uses a bottom-up approach to derive a classification (marine landscape types) based on the data available. Additionally the JNCC method has been able to validate the classification with ground-truth biological samples.

The merits of bottom-up approaches are that you can apply any habitat classification system to the final map, and it allows the most to be made of the "data" for multiple uses, without imposing restrictions in the form of existing habitat classification systems.

On the other hand, a top-down approach allows *a priori* definition of habitat classes, which are more amenable to developing policy prior to full knowledge of the distribution of those classes. This approach also provides management with a common reference system (e.g., EUNIS) spanning multiple mapping initiatives. It was noted that further validation of the EUNIS system is required, and that a balance between bottom-up and top-down approaches is needed to best achieve this.

Habitats versus marine landscapes: The "seascape" approach was considered useful where detailed biological data are lacking, and geophysical and oceanographic data can be used as a surrogate for the biology (in a predictive approach). Where more detailed biology is available, this can be integrated at an earlier stage in the analysis, giving greater confidence in the habitat types mapped. Essentially there are issues both in scale of definition of mapping units (landscapes are broader in definition than habitat types) and in degree of confidence in the resultant maps (all mapping requires a degree of extrapolation, but the higher quality mapping studies have better suites of data on which to base final interpretations).

The Working Group felt that further discussion was needed on use of the terms habitat and marine landscape/seascape and scale of definition of mapping units.

5.4.2 Data availability and access

Initial discussion about the type of data needed and their likely availability to the Working Group was further developed, at length, within the subgroup. These discussions are presented in Annex 13. Although access to the most suitable data was a challenge, the Working Group had made a good start in collating suitable data sets and was able to identify further data sets which members would access over the coming year. It was agreed that a spreadsheet listing the data required, their scale, geographical coverage, source and person assigned to access them would be drawn up. This would help ensure that there was minimal overlap of effort in acquiring data; this was especially important as NIVA (for the EEA) were continuing their EUNIS mapping task and the MESH project had a major data collation programme for the southern and western parts of the North Sea.

5.4.3 Progressing the development of a North Sea map

Recognising that several initiatives were working towards development of North Sea habitat maps, but that they were adopting different approaches and working to different time scales or levels of detail, WGMHM agreed that sharing of common data sets (and the task of accessing the data, as noted above) would be of great benefit to all. Kerstin Geitner offered to prepare the data acquired into suitable GIS format and Chris Cogan agreed to make these available to all via an ArcIMS web application. These activities should be completed in time for the 2005 WGMHM meeting, so that the Working Group could:

- Assess the coverage and usefulness of the data acquired to date,
- Review the developments in mapping the North Sea by the ongoing programmes (EEA, MESH, SGNSBP), including the merits of different approaches,
- Make further progress in the development of North Sea maps.

6 REVIEW PROGRESS ON INTERCALIBRATION AND QUALITY CONTROL OF MAPPING TECHNIQUES, INCLUDING THE PROPOSED WORKSHOP ON ADGS (ROXANN) TECHNIQUES AND TAKING INTO ACCOUNT THE WORK OF THE STUDY GROUP ON ACOUSTIC SEABED CLASSIFICATION (TOR F)

6.1 Findings on the workshop for use of RoxAnn as a mapping tool

Craig Brown presented a report detailing the results, findings, and recommendations of the 2003 RoxAnn Workshop, held at SAMS in Oban, UK.

In September 2003, a national workshop took place in the UK to assess the accuracy of the RoxAnn acoustic ground discrimination system (AGDS) as a tool for mapping seabed biotopes in candidate Special Areas of Conservation (SACs). A heterogeneous area of seabed, approximately 1 km^2 in size, was selected for the study. The area was first surveyed using a sidescan sonar system and a mosaic of the output was produced covering 100% of the survey area. Interpretation of the mosaic identified three acoustically distinct seabed types, the spatial distributions of which were mapped. Four RoxAnn data sets were then collected over the same area of seabed, applying different survey parameters (e.g., different survey grids, track spacing, survey vessels, survey speeds and RoxAnn systems). Extensive ground-truthing was carried out involving twenty-six drop-down video stations, and from these data, six benthic classes (life-forms) were identified. Following interpolation of the RoxAnn track point data to produce full-spatial coverage data, these six life-form categories were used to conduct supervised classification of the RoxAnn data to produce full-coverage habitat maps of the area for each of the four RoxAnn data sets. Comparisons were then made between the four RoxAnn maps and the sidescan sonar interpreted map. The accuracy of each map was assessed and the application of this mapping approach for mapping seabed habitats in candidate SACs was presented. The report of the workshop is given in Annex 14.

In discussion, it was recognised that accurate positioning had not been achieved and this could be a contributing factor to the low agreement between the various sets of survey data. As a general comment, smaller survey areas required more accurate positioning of the measuring devices in comparison to larger survey areas.

The size of the acoustic footprint with the deployed systems is large and even partial insonification of an outcropping rock would saturate the signal returns, thereby progressively overestimating the rocky component. This overestimation would be further exacerbated during interpolation of adjacent track data.

It was noted that to accurately map habitats with this RoxAnn method, the habitat must have an intrinsic and unique differentiating acoustic signature. In this case, the similar rocky habitats (bedrock and boulders) under study could not be separated acoustically, due largely to echosounder acoustic footprint size and track spacing, and therefore an overestimation of rock habitat was made, again exacerbated by interpolation between the single-beam data tracks.

Regarding the optimal echosounder frequency for ADGS work, Bob Foster-Smith considered that dual frequency systems provide a more successful classification by about 65–70% when compared to a single frequency system. The lower frequencies are generally more stable and provide more consistent results than higher frequencies, which tend to operate at a higher power, creating a larger footprint. Individual ADGS/echosounder set-ups will be system-specific depending on various combinations of power, frequency, beam footprints, etc. Other factors that must be taken into consideration include increased water depth, which progressively widens the echosounder beam angle and resulting footprint, and sediment type, wherein softer sediments permit more penetration of the acoustic signal.

WGMHM agreed that RoxAnn should be used as a complementary tool in combination with other techniques, for example, sidescan sonar or MBES (multibeam) systems, and had more limited use in isolation. RoxAnn data can provide good boundary information where, for example, sidescan sonar systems cannot resolve small-scale differences in the acoustic signatures. This facility permits further subdivision of the sidescan habitat classes and the numeric signature removes the requirement for a manual interpolation of a boundary, maximising data repeatability.

Issues were highlighted regarding the top-down imposition of a classification scheme (such as predefined EUNIS or Habitats Directive habitat types) as opposed to a bottom-up approach of allowing the data to be interpreted locally first. The top-down approach forces the data into predetermined classes and can cause misinterpretation of the data. As such, it was recommended that bottom-up approaches should normally be applied first, i.e., interpreting the data in a local context to produce a classification of habitat types. As a second stage process these types can be correlated to standard classification schemes, such as EUNIS. Such a two-stage process should lead to improved interpretation of data according to the quality of the techniques used but also enable the identification of types that are not adequately represented in national or international classification schemes (and hence lead to the modification of such schemes).

The differing resultant maps from the four RoxAnn data sets highlighted the need to thoroughly inform end users of generated maps as to the level of confidence and degree of accuracy of the interpolated data presented in the map. This is a generic problem which needed to be addressed for all maps, regardless of the underlying techniques and data used. At present there are likely to be inconsistencies between habitat maps generated by different workers who use the same data in the same study area because the process of interpretation involves a series of choices about the classes or divisions selected for each data set (acoustic and ground-truth). These inconsistencies would be minimised by adopting more standard approaches to data processing and classification, but it was felt there would always be some degree of inter-worker variation. Habitat designation from ground-truthing data (grabs, video) can be a somewhat subjective technique and, therefore, even a standard approach to acoustic classification can lead to inconsistencies in final maps. The use of a well-developed local and/or national habitat classification scheme with good reference video and stills footage would aid ground-truthing habitat designations and should reduce inter-worker variability. The consistent interpretation of benthic sample data is a prime driver of the UK national classification scheme, but local variation in habitat types would always be present. Adequate training in ground-truthing interpretation is also necessary. An additional quality assurance approach would be to undertake regular QA/QC workshops for habitat mapping workers. It must also be recognised that a “habitat” is a concept and mapping places somewhat artificial boundaries on continuous seabed features. It is additionally necessary to produce different types of map to suit the requirements of different end users.

Until inconsistencies in the interpretation of acoustic and ground-truth data are reduced, the resultant habitat maps will continue to have differences, leading to difficulties in edge-matching maps from different studies. Where maps are derived from different techniques, there is less likelihood of good edge-matching. Addressing these issues requires:

- Improved protocols for processing each data type (sidescan, multibeam, single, beam, grab, video, etc.) to reduce inter-worker variability;
- Further intercalibration exercises between workers to improve QA/QC;
- Further testing and development of standard habitat classification schemes, including linking between local mapping data and national/international schemes.

WGMHM acknowledged that the RoxAnn Workshop was a valuable exercise and provides clearer guidance on the use of RoxAnn systems and the confidence rating of the system. The issues that it raised about confidence in habitat types and boundaries between types on final maps are equally relevant to other techniques. Methods should be developed to present levels of confidence in the maps, both the habitat types and their boundaries.

6.2 New approaches in seabed characterisation for the Basque coast (seabed characterisation of the Bay of La Concha)

A study on the seafloor characterisation of the Bay of La Concha, San Sebastian (northeast Spain) was presented by Ibon Galparsoro. The principal aim of the work was to create a geomorphological map of the bay for use as a management tool.

Acoustic techniques, including the Acoustic Ground Discrimination System RoxAnn and sidescan sonar were used, with grab samples taken to calibrate the acoustic results. To maximise the acoustic data quality, all the RoxAnn data were recorded on the same day, in the same sea conditions, and with a high density of data (low distance between tracks). As the study area was very shallow (0–28 m depth), aerial images were also used for seabed cartography. All the data were geo-referenced and integrated into a GIS for spatial data analysis.

The RoxAnn data were interpolated using a linear triangulation method and a 1 m by 1 m resolution grid was produced. A supervised classification method was used to calibrate the acoustic data. 5-m-diameter polygons were created around each grab sample position and the acoustic data that intersected each polygon were selected for later analysis.

RoxAnn demonstrated an ability to classify correctly between different seabed types such as sand, rocks and bedrock. For hard substrata, in terms of the roughness, the distinguished seabed types were bedrock, rocks, mixed sand and rock, and gravel. Nevertheless, in terms of hardness, due to the low values of the second echo, the influence of the benthos coverage should be determined.

For soft substrata, it was found that the principal factors affecting the performance of the system were the grain size and the porosity of the sediment. There was a statistically significant relationship between grain size and RoxAnn roughness (E1) values at 99% confidence level. Otherwise, in terms of the proportional grain size content of the sediment, 95% of confidence level was found between roughness values and both gravel and sand content; and 90% confidence level between the mud content of the sediment and E1. On the other hand, the correlation of the hardness (E2) value and granulometric parameters were not statistically representative. Nevertheless, these data gave valuable descriptive information about the seafloor.

The RoxAnn data values also presented a high degree of correlation with the sidescan sonar data interpretation which was used for the interpretation of the seabed topography, texture, and bed sediment dynamics.

In general terms, it was demonstrated that RoxAnn was a useful tool for the characterisation of the seabed in this example, when used in conjunction with swathe (sidescan) and ground-truthing techniques. However, it was clear that the system must be properly calibrated in order to work to its full capability. RoxAnn provides complementary data to swathe systems and is thus best used in combination and integration with other acoustic techniques rather than on its own (with appropriate ground-truthing).

6.3 Study Group on Acoustic Seabed Classification

The report of the 2003 SGASC was examined. Its contents related primarily to a detailed table of contents for a proposed ICES Cooperative Research Report on Acoustic Seabed Classification. As such, WGMHM felt the work of the Study Group related more to item 4 (development of guidelines) and dealt with the report under that item.

7 CRITICALLY REVIEW THE ADVANTAGES AND CONSTRAINTS OF HABITAT MAPPING IN A MANAGEMENT CONTEXT (TOR D)

7.1 An integrated approach to the assessment of anthropogenic disturbance at sand and gravel extraction sites

David Limpenny presented a study on the use of habitat mapping to assess the impact of aggregate dredging on the seabed at a licensed site off the East Anglian coast, UK (Annex 15). The study used sidescan techniques, coupled with multibeam and single-beam surveys and ground-truthing by grab and video to monitor changes to the character of the seabed over a period of more than ten years. Differences in biota composition across the study site and through time were only fully understandable with the benefit of swathe imagery and acoustic data. Together these data sets enabled the influences of the aggregate dredging activities to be distinguished from the variation at the site caused by natural environmental differences (sediment type, depth).

The WGMHM acknowledge that the use of swathe systems in this type of management context should be the preferred approach in such monitoring and assessment studies. They considered that the generation of a geomorphological map, to which other data sets are appended, provided an essential level of information necessary to fully understand the nature of the study site and the relationship of any human impact on it. Swathe techniques have repeatedly proven to give quantitative results in industrial applications, such as dredging and dumping.

Brigitte Guillaumont quoted an example in France in which mapping techniques had been valuable in monitoring the impact of the extraction of maerl. In this case, the monitoring revealed that the distribution of kelp forest habitat in areas near to the maerl beds had been reduced from its original depth limit of 15 m to only 7 m. However, this was identified through *in situ* observation at specific sites and did not provide sufficient coverage for detailed mapping of this change.

7.2 MINCH Project

Craig Brown presented an overview of a recent habitat mapping project in Scottish coastal waters. The objective of the Mapping INshore Coral Habitats or **MINCH** project was to assess the current distribution and status of cold-water coral habitats to the east of the Island of Mingulay. Time and weather permitting, a series of additional sites were also to be examined on the Stanton Banks, in the Sound of Rum and to the west of Skye. The project was designed as a "demonstration project" to show the effectiveness of wide-area environmental assessment using multibeam echosounder surveys as part of a habitat mapping exercise. Before the survey, existing bathymetry and geology was reviewed to help guide the choice of survey areas.

Reefs formed by the cold-water coral *Lophelia pertusa* were identified in the surveys to the east of Mingulay where they formed characteristic seabed mounds. These mounds were clearly seen on the multibeam bathymetry and backscatter data records. The backscatter also revealed intriguing "trails" extending downstream from some of these mounds. Their composition and cause are currently unknown. Preliminary analysis suggests that it may be possible to identify coral mounds of this type and size from bathymetric data alone. However, future surveys must include sufficient seafloor inspection to ground-truth any such predictions. Video inspection of the seabed allowed a total of sixteen different biotope types to be identified. This information was summarised in the MINCH GIS project. Further work is now needed to characterise the diversity of the reef-associated communities, record the hydrographic regime, and complete detailed visual surveys of the reef habitat.

This presentation was well received by the WGMHM as a type example of where the combination of survey techniques has been used to successfully define an area of seabed which is important for nature conservation purposes (in this case for delivery of the EC Habitats Directive). In a management context, the survey protocols have been used to identify and map the distribution of a specific habitat type (cold-water *Lophelia* coral reefs). In addition, the study permitted the re-evaluation of vintage data sets, including correcting the georeferencing of historic data by matching to features revealed by modern techniques.

7.3 Discussion

The use of MBES (multi-beam echo sounder) systems enables wide ground coverage, which ultimately permits more informed decision making.

With respect to the benefits of habitat mapping to management issues, the following points were highlighted:

- The cost of a MBES survey is high. This can be minimised partially, and where possible, by employing demountable equipment spreads on smaller vessels. The comparative value, however, of MBES as a data layer available for interpretation is very high.
- In the design of a survey, the methodology and technology employed should be selected on the basis of their applicability to the intrinsic requirement of the survey and used discretely, rather than routinely.
- Where possible, use of other technologies, such as single-beam echosounders, should be used in parallel with a MBES survey.
- Additionally, the end user must be clearly informed as to the accuracies and repeatability of the systems and resultant maps, so that management decisions are made in the light of the quality/certainty of the data.

8 INITIATE COLLABORATION WITH THE STUDY GROUP ON BALTIC ECOSYSTEM HEALTH ISSUES (SGEH) ON THE DEVELOPMENT OF A HABITAT CLASSIFICATION FRAMEWORK AND HABITAT MAPS FOR THE BALTIC SEA [HELCOM 2004] (TOR G)

WGMHM discussed the HELCOM request on marine habitat mapping following an introductory perspective given by Eugeniusz Andrulewicz (SGEH Chair) and information provided by Dieter Boedecker (German member of WGMHM and the German delegate to HELCOM HABITAT):

- WGMHM is aware that a lot of activities and data related to marine habitat mapping of the Baltic Sea exist within the Baltic countries,
- It is unfortunate that attendance of Baltic experts in WGMHM activities is poor (so is reporting of Baltic countries to WGMHM). As a result, relevant information on Baltic mapping activities is available to ICES only on a limited scale,
- WGMHM is willing to offer their developments and advice in various levels and manners: as a direct discussion at WGMHM meetings; as papers, maps and reports; as electronic software; and as expert assistance and/or participation to Baltic habitat mapping projects.

Considering the forthcoming developments in the Baltic habitat mapping-related activities and noting the existence of “Red List of Marine and Coastal Biotopes and Biotope Complexes of the Baltic Sea, Belt and Kattegat”, and being aware that the main aim of the request from HELCOM for Baltic habitat mapping is habitat protection and ecosystem-based management, WGMHM recommends that the Baltic countries should:

- compile and complete information about the ongoing habitat mapping activities;
- compile information on available data relevant to the development of Baltic habitat maps, particularly: Coastline, bathymetry, seabed substrata, salinity, oxygen conditions, light penetration, temperature/ice cover, and wave/current action, drawing upon CHARM and other relevant initiatives;
- identify experts and key persons in the Baltic and establish a Baltic Sea sub-group on marine habitat mapping who should meet to develop specific proposals for a Baltic-scale project (similar in concept to the North Sea approach of the WGMHM (item 5)), taking into account end-user requirements, data availability, expertise, possible scales of resourcing, and timescales;
- undertake an effort to raise funds for a Baltic Sea LME MHM (large marine ecosystem marine habitat mapping) research project and prepare it for submission to suitable funding bodies (e.g., EU FP6, Interreg, HELCOM). This should be done with ICES and HELCOM [and EEA] involvement. WGMHM is of the opinion that it could be a

similar project proposal as the Interreg MESH programme for North-West Europe (which has recently been accepted and financed);

- raise national projects on regional marine mapping scales and/or on particularly valuable sea habitats according to HELCOM Rec. 21 - preferably on existing and planned BSPAs (Baltic Sea Protected Areas).

Finally, WGMHM urges the Baltic countries to raise financial support for national experts to participate in WGMHM activities. WGMHM particularly urges BSRP to support participation of eastern experts to WGMHM meetings.

9 REVIEW EXISTING PELAGIC HABITAT CLASSIFICATION SYSTEMS AND ASSESS THEIR RELATIONSHIPS TO BENTHIC HABITAT CLASSIFICATIONS (TOR C)

WGMHM recognises the important and controlling effect of overlying water masses and the pelagic environment on the development, character, and sustainability of the benthic marine habitat and its associated biota.

There was a general discussion on whether or not demersal fish should be considered in relation to the pelagic or benthic habitat environment; it was concluded that demersal fish have a close relationship to seabed type and are consequently best considered in relation to benthic habitats in this context. Seals, cetaceans and birds, in the context of pelagic classifications and mapping, were also briefly discussed.

The relationship of the pelagic environment to the benthos was reviewed and key controls identified. These can be divided into two:

- physical effects, including tides, currents, upwelling, overturning, frontal systems; and
- water mass properties, including temperature, salinity, density, oxygen, turbidity, nutrients.

The species diversity in similar *Zostera* seagrass habitats along the Brittany coastline was given as an example of latitudinal biogeographical zoning; it is possible to distinguish northern and southern assemblages. In the UK similar biogeographical influences on benthic habitats had been identified, with the classification of southwestern and north-eastern communities in similar habitat types (www.jncc.gov.uk/MarineHabitatClassification). The relationship of water masses and temperature regimes to benthic habitats required further study.

The influence of the pelagic environment is important also in temporal scales, both seasonal and annual. Movement of water masses brings larvae to benthic habitats and can significantly influence their species composition. In some circumstances, where mass recruitment of, for instance, bivalves to sediment habitats occurs, there can be a switching of community type in a benthic habitat.

In Belgium, sidescan sonar is used as the primary tool for defining the distribution of the bivalve *Macoma balthica* assemblages, as identified by their characteristic sidescan sonar acoustic signatures. In certain areas, where sidescan sonar identified potential *M. balthica* beds, ground-truthing showed that the community was significantly altered by the prevailing water masses.

It was suggested that perhaps re-examination of the limnological trophic classifications should be carried out with a view to adopting/adapting some of the classification levels/devices for use in marine bentho-pelagic mapping.

In conclusion, the members present felt insufficiently qualified to make progress on this matter and that expertise in pelagic communities and habitats was most likely available within other ICES groups (e.g., Working Group on Zooplankton Ecology (WGZE), Working Group on Phytoplankton Ecology (WGPE)). Links should be sought between these Working Groups.

10 ANY OTHER BUSINESS

10.1 Report of the November 2003 workshop on coastal biodiversity assessment

Christopher Cogan presented a report on a biodiversity workshop held in St. Petersburg, Russia, in November 2003 and sponsored by the International Arctic Science Committee (IASC). It focused on Arctic coastal biodiversity assessment and raised key issues relevant to WGMHM. These included the relationship between biodiversity assessment and habitat mapping, the development of goal-driven mapping approaches to avoid data-driven limitations, and the role of surrogate data for biodiversity analysis. It was noted that the term “biodiversity” was not limited to the sole consideration of species diversity, but also incorporated compositional, structural, and functional concepts.

The item concluded with a general discussion on the application of biodiversity assessment for improved marine management and protected area design. David Connor also presented examples of work from the Irish Sea Pilot (Lieberknecht *et al*., 2004[3]) which had used the decision-making software Marxan to identify a representative series of biodiversity areas based on the habitat mapping information available.

10.2 OSPAR revision of the EUNIS habitat classification for the Northeast Atlantic

A review and updating of the marine elements in the EUNIS habitat classification system relating to the northeast Atlantic had recently been completed for the OSPAR Biodiversity Committee. The revision was based on two major outputs, namely a literature review by each of the OSPAR Contracting Parties of habitats in their respective countries and a major revision of the MNCR marine habitat classification scheme used in the UK. The revised classification had been presented to, and accepted by, the OSPAR Biodiversity Committee in February 2004 who now recommended its acceptance by the European Environment Agency. A document outlining this revision had been circulated to WGMHM members prior to the present meeting and was discussed (Annex 16). The meeting welcomed the revision, which corrected some anomalies of its predecessor and provided greater depth to the hierarchical structure of the system in areas particularly relevant to sublittoral sediments and circalittoral rock habitats. Some specific discussion ensued relating to classification of habitats characterised by invasive species (e.g., non-native oysters). The revision represented a significant advance of the EUNIS system and now required extensive testing and evaluation, particularly through mapping programmes.

10.3 OSPAR priority habitat mapping programme

A proposal had been made to OSPAR in 2003 to consider mapping marine habitats throughout its region of jurisdiction (Northeast Atlantic). To initiate the process, OSPAR had identified ten priority habitats and a further four habitats had recently been recommended for adding to this list after consideration by the OSPAR Biodiversity Committee. David Connor informed the meeting that the programme for mapping the OSPAR priority habitats had just started and would collate point-location data on these habitats with a view to compiling distribution maps for each habitat type that will be presented to the Biodiversity Committee in 2005.

11 ACTIONS AND RECOMMENDATIONS

The working group discussed its future direction and considered that it should continue its efforts on a focused mapping project for the North Sea, which would both result in a useful end product and help highlight issues (e.g., data compatibility) that needed further attention. Intersessional work would be undertaken to gather the necessary data sets into a GIS so that the next meeting could be as productive as possible. There was discussion as to the computer facilities needed to undertake such work during the meeting; it was concluded that GIS capability on laptops would be adequate as it was anticipated that all necessary data sets would have been compiled beforehand. Taking this North Sea focus into account, together with a wish to encourage participation of Baltic Sea countries, the offer from Chris Cogan to host the meeting at the Alfred Wegener Institute in Bremerhaven, Germany was gratefully received.

The following intersessional work would be undertaken:

1) All members to advise on existing standards of relevance to habitat mapping (to Roger Coggan, CEFAS) by 7 May 2004).
2) Roger Coggan to liaise with John Anderson (Chair of SGASC) regarding scope and content of the proposed Cooperative Research Report on Acoustic Seabed Mapping Techniques before next SGASC meeting in Poland, 17–19 April 2004.
3) All members to provide additional comments on the metadata fields for each mapping technique (see Annex 12) to Neil Golding, JNCC) by 7 May 2004; revised metadata standards to be presented at 2005 WGMHM.
4) Progress reports from MESH /EEA EUNIS/Baltic regions/ICES North Sea work.
5) Discussion primer for habitat mapping decision tree for environmental managers (Bob Foster-Smith, Envision), and case examples of map use (ALL relevant participants) by end of January 2005.

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[3] Lieberknecht, L.M, Connor, D.W., and Vincent, M A. 2004 The Irish Sea Pilot - Report on the identification of nationally important marine areas in the Irish Sea. Peterborough, Joint Nature Conservation Committee and online at www.jncc.gov.uk/IrishSeaPilot.

6) List of applications for habitat maps to be integrated into discussion primer (above) (David Connor, JNCC) by end of January 2005.
7) Circulate report on the protocol and standards development from the MESH project (Roger Coggan, CEFAS; Jacques Populus, IFREMER).
8) All members to identify suitable data sets and provide in GIS format to Kerstin Geitner (DIFRES) (on-going but cut-off date of end-January 2005).
9) GIS data supplied to DIFRES to be added to ArcIMS by Chris Cogan (AWI) by end-February 2005.

The following draft Terms of Reference for the 2005 meeting were recommended (Annex 17):

The Working Group on Marine Habitat Mapping [WGMHM] (Chair: D. Connor, UK) will meet in Bremerhaven, Germany from 5–8 April 2005 to:

International programmes (Baltic, MESH North-West Europe, North Sea)

a) Develop a benthic/pelagic habitat map for the North Sea, based on data sources compiled or made available to the Working Group and compiled into a GIS, and to assess future data requirements and issues arising from the process;
b) Compare international habitat mapping methodologies, and work towards a best practice approach;
c) Review progress of international mapping programmes (e.g., MESH, EEA, Baltic, ICES);

National programmes (National Status Reports)

d) Present and review National Status Reports on habitat mapping activity during the preceding year according to the standard reporting format (presentations limited to 10 minutes per country).

Mapping strategies and survey techniques

e) Review progress on intercalibration and quality control of mapping techniques. To construct a habitat mapping decision tree that can be applied to various management issues, identifying base requirements and evaluate the incremental values of mapping techniques (primer document to be circulated 3 months prior to meeting);
f) To review the activities of the SGASC relating to acoustic seabed classification.

Protocols and standards for habitat mapping

g) Develop a working definition of the terms habitat and marine landscape/seascape for the purposes of mapping;
h) Further progress the development of guidelines for habitat mapping, including the review of developments of protocols and standards for habitat mapping within the MESH project and other relevant initiatives (a report of the MESH project should be circulated prior to the meeting);
i) Report on progress in the development of metadata standards for marine habitat mapping.

Uses of habitat mapping in a management context (human activities; implementation of Directives and Conventions)

j) Review the application of and needs for habitat maps in a management context, including case studies to illustrate particular applications.

Relevance of habitat mapping to other aspects of marine ecosystems (fisheries, pelagic)

None proposed for 2005, due to the extent of other proposed Terms of Reference.

12 ADOPTION OF THE REPORT

The draft report and list of annexes was discussed by the working group before the close of the meeting. It was circulated to the participants for comment before finalising.

13 CLOSE OF MEETING

The Chair David Connor thanked Brigitte Guillaumont and the IFREMER staff for hosting the meeting and for providing such excellent facilities with which to have a productive and forward-looking meeting.

Annex 1 List of participants

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Annex 2 Terms of Reference for 2004 WGMHM

2E07 The **Working Group on Marine Habitat Mapping** [WGMHM] (Chair: D. Connor, UK) will meet in Brest, France, from 30 March–2 April 2004 to:

a) commence development of a generic benthic/pelagic habitat mapping framework for the North Sea, and to produce a prototype habitat map of the North Sea that could be useful for the interpretation of the North Sea Benthos Project;

b) present and review National Status Reports on habitat mapping according to the standard reporting format;

c) review existing pelagic habitat classification systems and assess their relationship to benthic habitat classifications;

d) critically review the advantages and constraints of habitat mapping in a management context;

e) further progress the development of guidelines for habitat mapping;

f) review progress on intercalibration and quality control of mapping techniques, including the proposed workshop on AGDS (Roxann) techniques, and taking into account the work of the Study Group on Acoustic Seabed Classification;

g) initiate collaboration with the Study Group on Baltic Ecosystem Health Issues (SGEH) on the development of a habitat classification framework and habitat maps for the Baltic Sea [HELCOM 2004].

WGMHM will report by 23 April 2004 for the attention of the Marine Habitat and the Fisheries Technology Committees, as well as ACE.

Supporting Information:

Priority	This group coordinates the review of habitat classification and mapping activities in the ICES area and promotes standardization of approaches and techniques to the extent possible.
Scientific justification and relation to Action Plan	a. WGMHM has met for a number of years and has extensively discussed issues related to habitat mapping including: - data collection methodologies, technologies, - data management, - habitat classification systems, and - data exchange and integration. It is apparent that adequate technologies presently exist, significant data holdings exist and that there are a large number of approaches and pilot products demonstrating the generation of habitat maps. A number of these approaches have been developed and presented by Working Group members for the southern North Sea, northern Spain, shallow water and intertidal U.K., eastern North American, and other areas. The challenge is to develop an agreed framework for habitat mapping; the North Sea should be used as a pilot area, based on existing data which, as a minimum, should include bathymetry, surficial sediments and relevant ICES information on the distribution of marine benthos. The working group will develop a framework and test it for usefulness across national boundaries. If successful, this framework could be tested and revised for larger ICES areas. The product will be a generic habitat mapping framework, demonstrated as a habitat map of the North Sea and highlighting a recommended approach to integrating and interpreting various data layers into useful maps. It is anticipated that this will be a habitat analogue to the accepted International Hydrographic Organisation (IHO) nautical charts that are used world-wide to provide a synopsis of varied and diverse hydrographic information in a consistent and useful format. The geographic area to be covered is from the high water mark to deep water of the North Sea (according to the OSPAR Quality Status Report Region II and ICES areas VIIE, VIID, VIA, IVB, IVC).

	Preparation: Before the Meeting, GIS map layers will be compiled into an appropriate system for overlaying available information for active querying during the meeting. Efforts will be made to allow Meeting participants access to all information layers three months before the Meeting. b. The compilation of National Status Reports is required to keep abreast of current activities and bring attention to new initiatives, developing techniques and data availability. c. Approaches to the classification of pelagic habitats requires further development, including assessment of their relationship to seabed habitats and ecosystem functioning. d. Whilst habitat maps may have many different purposes, their use in a management context is particular important to show the benefits of this field of work. e. & f. Continued development of guidelines and standards is necessary to improve the quality of habitat mapping studies, to increase the compatibility of generated data and to facilitate the aggregation of habitat mapping information for national and international reporting purposes. g. This WG had been tasked with development of a habitat classification framework and maps for the Baltic. Little progress was made due to the lack of participation by Baltic countries. This task will be taken on by SGEH with funding under the BSRP. WGMHM will work closely with SGEH on this work. Action Plan: 1.4.1, 1.4.2, 1.4, 1.4.3
Resource requirements	
Participants	Representatives from Member Countries with experience in habitat mapping and classification.
Secretariat facilities	
Financial:	
Linkage to Advisory Committee	ACE
Linkages to other Committees or groups	Discuss need for joint meeting with BEWG and WGEXT and SGASC; Baltic Committee. SGASC and SGEH
Linkages to other organizations	OSPAR, HELCOM, EEA
Secretariat Cost share	ICES 100 %

Annex 3 Agenda for the meeting, ICES Working Group on Marine Habitat Mapping, Brest, France 30 March–2 April 2004

Tuesday 30 March

1000 (The room will be open at 0830 and coffee available before 1000)

1 Opening of meeting

1.1 Local organisation

1.2 Appointment of Rapporteurs

1.3 Terms of Reference

2 Adoption of Agenda

3 Presentation and review National Status Reports on habitat mapping and classification activities, according to the standard reporting format (TOR b)

3.1 Canada (Vladamir Kostylev)
Habitat mapping on German Bank, Gulf of Maine (Brian Todd, Geological Survey of Canada Atlantic)
Scotian Shelf habitat mapping (Vladimir Kostylev, Geological Survey of Canada Atlantic)

3.2 UK (Craig Brown)
Interreg MESH project (David Connor)

3.3 France (Brigitte Guillaumont)
Ifremer data centre (particularly national geophysical data bank) (Eric Moussat)

3.4 Belgium – current and future mapping approaches (Vera Van Lancker)

3.5 Denmark (Johnny Reker)

3.6 Baltic Sea region (Eugene Andrulewicz)

3.7 Ireland (Fiona Fitzpatrick)

3.8 Netherlands (Norbert Dankers)

3.9 Norway (report submitted by John Alsvåg)

3.10 USA (report submitted by Thomas Noji)

5 Commence development of a generic benthic/pelagic habitat mapping framework for the North Sea, and to produce a prototype habitat map of the North Sea that could be useful for the interpretation of the North Sea Benthos Project (TOR a)

5.1 Introduction and organisation of GIS session for Wednesday (Brian Todd, Geological Survey of Canada)

5.2 EEA presentation on development of EUNIS habitat maps for the North Sea (Kjell Magnus Norderhaug, NIVA, Norway)

5.3 Irish Sea Pilot marine landscapes approach (Neil Golding, JNCC, UK)

5.4 SGNSBP update

20 00 Working Group Dinner "chez Maître Kanter", Brest

Wednesday 31 March

5	Cont. - North Sea GIS mapping (sub-group to work in parallel)
4	Further progress the development of guidelines for habitat mapping (TOR e)
4.1	MESH project – development of protocols and standards (Roger Coggan, CEFAS, UK)
4.2	Development of metadata standards for mapping techniques – an initial discussion (David Connor, Neil Golding, JNCC, UK)
7.2	Habitat mapping of tidal areas (using orthophotographs, Spot imagery, lidar and in situ measurements) and subtidal areas (using multibeam, side scan, video and sampling) (Jacques Populus, Axel Ehrhold and Claire Rollet, Ifremer, France)
9	Review existing pelagic habitat classification systems and assess their relationship to benthic habitat classifications (TOR c)
9.1	[All – to consider what information can be contributed to this ToR]
10	Any other business
10.1	Report of the November 2003 workshop on coastal biodiversity assessment (Chris Cogan, Alfred Wegener Institute for Polar and Marine Research, Germany)
10.2	OSPAR revision of EUNIS habitat classification for north-east Atlantic (David Connor)
10.3	OSPAR priority habitat mapping programme (David Connor)
1900	**MESH meeting; sideboard meal (for MESH participants)**

Thursday 1 April

5	Cont. North Sea GIS mapping – presentation of results and issues, followed by discussion (Brian Todd et al)
6	Review progress on intercalibration and quality control of mapping techniques, including the proposed workshop on AGDS (Roxann) techniques, and taking into account the work of the Study Group on Acoustic Seabed Classification (TOR f)
6.1	Findings of the workshop for use of RoxAnn as a mapping tool (Craig Brown, SAMS, UK)
6.2	New approaches on seabed acoustic characterisation in the Basque coast (Ibon Galparsoro, AZTI, Spain)
8	Initiate collaboration with the Study Group on Baltic Ecosystem Health Issues (SGEH) on the development of a habitat classification framework and habitat maps for the Baltic Sea [HELCOM 2004] (TOR g)
8.1	Assisted by discussions with Chair of SGEH (Eugene Andrulewicz) and EEA lead on EUNIS mapping (Kjell Magnus Norderhaug, NIVA)
7	Critically review the advantages and constraints of habitat mapping in a management context (TOR d)
7.1	An integrated approach to the assessment of anthropogenic disturbance at sand and gravel extraction sites (David Limpenny, CEFAS, UK)
7.2	MINCH project (Craig Brown, SAMS, UK)
1545	Ifremer Brest Center visit (90 min.)

0900 **Friday 2 April**

11 Recommendations and actions

12 Adoption of the report

13 Close of meeting

1300

Papers/reports already circulated:

Moy, F. (2003) Holistic mapping of potential occurrence of marine habitats: state of play 2003. ETCWC for EEA (Paper 04/3/7 to OSPAR Biodiversity Committee)
ICES WGMHM 2003 report (April 2003)

ICES Study Group on Acoustic Seabed Classification report (June 2003)

OSPAR Biodiversity Committee: proposed revision to EUNIS marine habitat classification

To be available at the meeting:

Poster:
"New marine geoscience and habitat map products from the Geological Survey of Canada" (Brian Todd)
Published report:
Le Bot, S., Van Lancker, V., Deleu, S., De Batist, M., and Henriet, J.P. 2003. Tertiary and Quaternary geology of the Belgian continental shelf. PPS Science Policy, SPSDII, D/2003/1191/12, 75pp.
Poster:
Long-term bottom changes using several acoustics surveys on the same area (example of Dieppe area) (C. Augris, Ifremer, France)

Annex 4 National status reports for 2004

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Belgium									
Ghent University, Renard Centre of Marine Geology: Vera Van Lancker	Belgian continental shelf: typical mud, sand and gravel areas	MAREBASSE	2002–2006. Yearly reports	Multibeam echosounder, side-scan sonar, RoxAnn AGDS, Medusa (natural radioactivity), video, different sampling techniques, hydrodynamic and sediment transport measurements	Physical and biological habitat descriptions and distributions, video, bathymetry, acoustic classification maps, large- and small scale modelling results, targeted end-users maps	set-up of integrated assessment framework for marine aggregates, optimisation of seabed mapping and classification, hydrodynamic and sediment transport modelling (depth: 8-40 m)	reports to thje Belgian Science Policy Office, publications, maps, workshops	local; will be updated to EUNIS in the MESH project	aggregate industry, dredging and dumping, windmill industry and their related government representatives
Ghent University, Renard Centre of Marine Geology: Vera Van Lancker	Belgian continental shelf	GAUFRE	2003–2004. Yearly reports	ArcGIS; existing datasets	practical habitat maps as a basis for impact maps on anthropogenic activities	Towards a spatial structure plan for the Belgian part of the North Sea	reports to the Belgian Science Policy Office, publications, maps, workshops	local; will be updated to EUNIS in the MESH project	all user functions of the North Sea
Ghent University, Renard Centre of Marine Geology: Vera Van Lancker	Belgian continental shelf	BWZee	2004-2006. Yearly reports	ArcGIS; existing physical and biological datasets	zonation based extrapolation of physical datasets to predict benthic communities	Set-up of a biological valuation map of the Belgian continental shelf	reports to thje Belgian Science Policy Office, publications, maps, workshops	local; will be updated to EUNIS in the MESH project	all user functions of the North Sea
Canada									
Geological Survey of Canada (Atlantic), (Dr Brian J. Todd)	Canada, Gulf of Maine	Benthic habitat mapping of the Gulf of Maine	1 April 2003 to 31 March 2006	Multibeam sonar, seismic reflection profiling, sidescan sonar, sediment coring and grab sampling, video and still photography	ESRI ArcGIS coverage including bathymetry, backscatter, sediment grain size, videography and photography, surficial geology and benthic habitat maps	Banks range from 30 to 100 m, troughs and basins reach 300 m; regional multibeam sonar surveys are followed by groundtruth surveys to obtain both regional samples and samples of particular interest	Digital maps published by the Geological Survey of Canada, Digital Atlas of the Gulf of Maine, scientific publications in peer-reviewed journals	Local classification scheme (I.e. northeastern US and eastern Canadian waters) has been developed by tailoring EUNIS and other schemes	Governments (federal, provincial and state), NGOs, fishing industry, hydrocarbon industry, cable and pipeline industries
Geological Survey of Canada (Atlantic), (Dr Vladimir E. Kostylev)	Canada, Eastern Scotian Shelf	Geoscience for Eastern Scotian Shelf Integrated Management	April 2003 to March 31, 2006	Compilation of legacy data on geology and benthos; Collection of seismic, sidescan sonar data, sediment coring and grab sampling, video and still photography	GIS maps of surficial and subsurface geology and habitat type, database of benthic megafana from optical samples and macrofauna from grab samples.	30 to 1000 m water depths, from nearshore to upper shelf slope.	Digital maps published by the Geological Survey of Canada, scientific publications in peer-reviewed journals	Habitat template based on disturbance and scope for growth as developed and applied to Scotian shelf	Governments (federal, provincial and state), NGOs, fishing industry, oil and gas industry, cable and pipeline industries

Organisation, name of contact person*	**Geographical coverage (country, region)***	**Project title**	**Date of work, expected year of reporting***	**Techniques used (e.g., acoustics, ground-truthing)***	**Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)***	**Brief description of work (including depth range)**	**Outputs: Reports, publications, maps, reference lists**	**Classification used; local (within project), national (state), EUNIS**	**Targeted end-users**
Department of Fisheries and Oceans Bedford Institute of Oceanography (Dr Donald Gordon)	Six 10 x 10 km boxes on the Scotian Shelf off eastern Canada (Emerald, Western and Sable Island Banks)	Spatial utilization of benthic habitat by demersal fish	2001–2005 Results will be released when available	Sidescan sonar, QTC seabed classification, DT Biosonics fish assessment, towed (Towcam) and tethered (Campod) video, still photography (both Towcam and Campod), grab sampling and experimental fishing with otter trawl.	Bathymetry Physical habitat (i.e. sidescan, QTC, video, photos and grabs) Benthic communities (i.e. video, photos and grabs) Fish communities (i.e. Biosonics, video, photos and trawl) Stomach contents of fish	Large team effort including scientists from DFO at both the Bedford Institute (BIO) and the Northwest Atlantic Fisheries Centre; also scientists from the Natural Resources Canada at BIO. Conducting surveys at the six 10 x 10 km study sites. Depth range 40–70 m. Sites selected after analysis of historical groundfish data (32 years). Three sites have the highest probability of encountering juvenile haddock (hot spots) while three sites have the lowest probability of encountering juvenile haddock (cold spots). Selected paired hot and cold spots on each of the three banks. Data are gathered on annual cruises run in September/October after juvenile haddock have settled to the bottom. Different data sets are being compared. Also attempts at data synthesis and extrapolation.	Multiple outputs are expected including maps, reports at scientific meetings, and publications.	No decision yet. Most likely local but done with knowledge of other classification systems. Habitat is being assessed by different tools (i.e. acoustic, imagery, and sampling) and by different team members.	Scientific community, resource managers, offshore industry (e.g., oil and gas, fishing), NGOs, etc.

Organisation, name of contact person*	**Geographical coverage (country, region)***	**Project title**	**Date of work, expected year of reporting***	**Techniques used (e.g., acoustics, ground-truthing)***	**Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)***	**Brief description of work (including depth range)**	**Outputs: Reports, publications, maps, reference lists**	**Classification used; local (within project), national (state), EUNIS**	**Targeted end-users**
Geological Survey of Canada (Atlantic), (Dr Steve Blasco)	Canada, Beaufort Sea	Benthic Habitat and Offshore hydrocarbon development in the Beaufort Sea.	April 2002 to March 2007	Multibeam bathymetric surveys, sidescan surveys, photo and video sampling, box cores, grabs.	GIS maps of bathymetry, backscatter, grain size, iceberg scouring rates, benthic biomass and diversity.	0-200 m, as ice conditions permit.	Digital maps published by the Geological Survey of Canada, scientific publications in peer-reviewed journals.	Habitat template based on disturbance and scope for growth as developed and applied to Scotian shelf	Governments (federal, provincial and state), NGOs, fishing industry, oil and gas industry, cable and pipeline industries
Geological Survey of Canada (Atlantic) and Department of Fisheries and Oceans, (Dr Vladimir E. Kostylev)	Canada, Scotian Shelf and upper slope	Interdepartmental (horisontal) initiative on Scotian Shelf Habitat mapping	April 2002 to March 2005	Compilation and integration of various data on oceanography, biology and geology of Scotian shelf seabed into a decision support system for habitat management.	GIS maps of water temperature, salinity, tidal and circulation currents, bathymetry, sediment grain size, seabed features, productivity regime, light penetration, variability in oceanographic factors. Database on biomass and diversity of benthos. Linked with GESSIM.	30 to 1000 m water depths, from nearshore to upper shelf slope. Large participation of DFO scientists in preparation of ocenaographic maps, and modeling of disturbance and productivity regime.	Digital maps published by the Geological Survey of Canada, scientific publications in peer-reviewed journals. Regional Advisory Process Report for Department of Fisheries and Oceans.	Habitat template based on disturbance and scope for growth as developed and applied to Scotian shelf	Governments (federal, provincial and state), NGOs, fishing industry, oil and gas industry, cable and pipeline industries
Geological Survey of Canada (Atlantic), Dr. Kim Conway, Vaughn Barrie	Queen Charlotte Basin, Canada	Queen Charlotte Basin ocean management: Benthic habitat mapping, sponge reefs.	1 April 2003 to 31 March 2006	Multibeam, sidescan, ROV, sampling.	Integrate oceanographic, marine geological and biological data sets to prepare comprehensive description of sponge reefs as distinct habitat	150–250 m shelf of British Columbia.	Seabed habitat maps for 6 areas identified by DFO as containing diverse populations of groundfish species; Multibeam bathymetry maps; Establish the extent and conditions that determine the health and survival of the globally unique sponge reefs. Habitat maps of the hexactinellid sponge reef complexes	none applied yet	Department of Fisheries and Oceans, Natural Resources Canada, various stakeholders.
Denmark									

Organisation, name of contact person*	**Geographical coverage (country, region)***	**Project title**	**Date of work, expected year of reporting***	**Techniques used (e.g., acoustics, ground-truthing)***	**Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)***	**Brief description of work (including depth range)**	**Outputs: Reports, publications, maps, reference lists**	**Classification used; local (within project), national (state), EUNIS**	**Targeted end-users**
Jørn Bo Jensen GEUS Øster Voldgade 10 DK-1350 Copenhagen K Denmark, Tel: +45 38142000 Fax: +45 38142050	The Danish Territorial Waters	Mapping of marine Annex 1 habitats in Denmark (Natura 2000 code 1110, 1140 and 1170)	1980–2000, review produced in 2000	Review based on existing datasets acoustics, ground truthing, models and literature	Digital maps of the distribution of marine Annex 1 habitats (1110, 1140 and 1170)	Mapping of marine Annex 1 habitats in Denmark (Natura 2000 code 1110, 1140 and 1170) using existing data on bathymetry, marine aggregates and seismic data.	Jensen, J.B. 2000. Kortlægning af marine naturtyper i Danmark i forbindelse med EF-Habitatdirektivet.GEUS Rapport no. 2000/106	None	DK Gov't Dept's, Industry
Jørgen O. Leth GEUS Øster Voldgade 10 DK-1350 Copenhagen K Denmark, Tel: +45 38142905 Fax: +45 38142050 E-mail:; jol@geus.dk	Eastern North Sea, west coast of Jutland, Denmark	Geological mapping off the Danish west coast	1991–2001	Acoustics (sidescan sonar, boomer, pinger, chirp sonar, watergun, sparker), ground truthing (sediment coring and grab sampling)	Bathymetry, sediment grain size, geology maps	Survey of the geological composition of the seafloor and sediment transport analysis along the coast of Jutland. Depth range 0-50 m	GEOLOGI - nyt fra GEUS nr. 3. Leth, J.O. 2003. Nordsøen efter istiden - udforskningen af Jyske Rev. GEOLOGI - nyt fra GEUS nr. 4 Larsen, B. 2003. Blåvands Huk - Horns Rev området - et nyt Skagen?	None	DK Gov't Dept's, Industry
Zyad Alhamdani GEUS Øster Voldgade 10 DK-1350 Copenhagen K Denmark, Tel: +45 38142905 Fax: +45 38142050 E-mail: azk@geus.dk	The Great Belt, Inner Danish Waters.	Seabed classification and habitat mapping of stone reefs in Denmark	2003	Multibeam and ground truthing (grap sampling, under water video and still photography) and Quester Tangent software	Bathymetry, sediment grain size, geology maps	Seabed mapping and classification of sediment as well as biomass contents of stone reefs. Depth range 3-20m	Poster: Alhamdani, Z. K., Lundsteen S., Jensen, J. B. Sea-bed classification and habitat mapping of stone reefs in Denmark. A multibeam and ground truthing pilot study. Available at azk@geus.dk	None	DK Gov't Dept's

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Jonas Teilmann NERI Frederiksborgvej 399 DK-4000 Roskilde Denmark Tel: +45 46301947 Fax: +45 4630 1114 E-mail: jte@dmu.dk	Inner Danish Water, western Baltic, North Sea (DK) and area around the Shetland Isle (UK)	Satellite tracking of Harbour Porpoise (Phocoena phocoena) in Danish waters and surrounding seas.	1997–2002, date of reporting 2004	Satellite tracking, biological sampling	Biological, homerange area maps	From 1997 to 2002 Harbour Porpoises were marked with satellite transmitters and a number of areas important for Harbour Porpoises were identified.	Teilmann, J., Dietz, R., Larsen, F., Desportes, G., Geertsen, B.M., Andersen, L.W., Aastrup, P., Hansen, J.R. & Buholzer, L. 2004: Satellitsporing af marsvin i danske og tilstødende farvande. Danmarks Miljøundersøgelser 86 s. NERI Technical Report no. 484	None	DK Gov't Dept's
Bo Riemann NERI Dept. of Marine Ecology Frederiksborgvej 399 PO Box 358 DK-4000 Roskilde, Denmark Tel: +4546 3012 00 Fax: +4546 3012 11	The Baltic Sea	Characterisation of the Baltic Sea Ecosystem: Dynamics and Functions of Coastal Types (CHARM).	2002–2004, date of reporting 2005	Wide range of physical, hydrochemical and biological data generated from national monitoring programmes.	Predictive models of hydrochemical compounds with maps. Distribution maps for infauna and macrophytes and predictive models. Draft typology.	Development of a typology for the Baltic ecoregion on the basis of hydrographic and biological variables. Evaluate and modify the typology with respect to the biological indicators of the Water Framework Directive.	Second annual report covering the preiod 1st. Dec. 2001to 30th Nov. 2003. Characterisation of the Baltic Sea Ecosystem (CHARM), In press.	Local ?	Gov't Dept's in Denmark, Poland, Sweden, Finland, Latvia, Lithuania Estonia, Germany and Italy
Jesper Andersen NERI Dept. of Marine Ecology Frederiksborgvej 399 PO Box 358 DK-4000 Roskilde, Denmark Tel: +4546 3012 00 Fax: +4546 3012 11	Denmark (aquatic and terrestic environment)	NOVANA (national monitoring programme)	2004–2009 (continued from previous monitoring programmes since 1987). Reports produced every year.	Wide range methods to collect physical, hydrochemical and biological data.	Among the outputs are distribution maps for macrophytes and predictive models. Marine habitat mapping is not a priority	NOVANA integrates environmental monitoring of aquatic and terrestical ecosystems and ensures a coherent approach at a national level.	NOVANA 2003. Programbeskrivelse del 1-3. Several technical guidelines and status reports (most in Danish). Published on \www.dmu.dk	None	National and regional authorities in Denmark

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Kerstin Geitner DIFRES Department of IT-T Charlottenlund Slot DK-2920 Charlottenlund, Denmark Tel: +45 3396 3354 Fax: +45 3396 3333 kjg@dfu.min.dk	Specific areas for mussels in Denmark (Wadden Sea, Limfjord, Little Belt)	National monitoring of mussels	ongoing, annual status reports	Aerial photography, ground truthing	Distribution maps for different mussels	Depth range 0-15 meters. Annual surveys of mussel beds based on interpretation of aerial photography. Quality control based on field surveys.	DIFRES report, available on webpage. http:/www.difres.dk	None	DK Gov't Dept's
Estonia									
To be compiled (Georg Martin)									
Finland									
Alleco Ltd -Jouni Leinikki	Finland	Classification of Baltic marine biotopes - criteria, definitions and EUNIS compatibility	June 2003–April 2004	Literature, existing data	Classification system, list of found biotopes, criteria for creating new biotopes and instructions for data collection are defined	Final report ready at the beginning of April, 2004	EUNIS, new local	Bathymetry, physical habitat, biological habitat, biotope names	Data collectors, scientists, planners, decision makers
Alleco Ltd -Jouni Leinikki	Finland	Testing marine habitat mapping methods	August 2004–December 2004	Acoustic, cable video, divers, GIS	Mapping underwater habitats with a hierarchical approach from coarser to fine-scale methods; 0-20 meters	Final Report	EUNIS, new local	Bathymetry, physical habitat, biological habitat, biotope names	Data collectors, scientists, planners, decision makers
Alleco Ltd -Jouni Leinikki	Latvia	Testing marine habitat mapping methods	June 2004–Dec 2004	Acoustic, cable video, divers, GIS	Mapping underwater habitats with a hierarchical approach from coarser to fine-scale methods; 0-20 meters	Final report	EUNIS, new local	Bathymetry, physical habitat, biological habitat, biotope names	Data collectors, scientists, planners, decision makers
Alleco Ltd -Jouni Leinikki: CORPI, Sergej Olenin	Lithuania	Biodiversity study and mapping of marine habitats in the vicinity of the Butinge Oil Terminal, Lithuanian coastal zone, Baltic Sea	June 2002–March 2004	Acoustic, cable video, divers, GIS	Mapping underwater habitats with a hierarchical approach from coarser to fine-scale methods; 0-30 meters	Final report	local	Bathymetry, physical habitat, biological habitat, biotope names	Data collectors, scientists, planners, decision makers

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Alleco Ltd, Panu Oulasvirta	Finland	Mapping of Natura 2000 habitats in Vuosaari Natura 2000 area	July 2003–April 2004	Acoustic, cable video, divers, GIS	Mapping underwater habitats with a hierarchical approach from coarser to fine-scale methods; 0-15 meters	Final report	Natura 2000, (Data for EUNIS and local system is used in the classification project mentioned above)	Bathymetry, physical habitat, biological habitat, biotope names	Planners, decision makers
Alleco Ltd, Panu Oulasvirta	Finland	Mapping of underwater biotopes in Otsolahti, Espoo	August 2002	Divers, aquascope	Mapping underwater vegetation and biotopes of a sheletred, shallow bay in Southern Finland; 0-7 meters	Final report	local	Physical and biological habitats, vegetaton to the species level	Planners, decision makers
Alleco Ltd	Finland, Estonia, Lithuania	Numerous underwater nature mapping projects	1991–2001	Divers, aquascope, acoustics, remote video, diver operated video, aerial photography	Mapping underwater habitats with a hierarchical approach from coarser to fine-scale methods; 0-25 meters	See http://www.alleco.fi/public.html	Local, HELCOM	Bathymetry, physical habitat, biological habitat, biotope names	Scientists, planners, decision makers
Alleo Ltd, Jouni Leinikki and Viktoras Didziulis	Lithuania, Finland	Developing Allmaps tool to assist underwater habitat mapping	June 2001 - still continuing	Desktop work	Developing a predicting tool and testing it with ground truth data	www.alleco.fi/allmaps/	Any	Predictions of spatial features	Scientists, planners, decision makers
Alleco Ltd	Finland	Scientific diver training	Since 1996	Theoretical and practical training methods	Training of biologists to work underwater, special emphasis on underwater biological mapping	About 90 professional scientific divers from 8 countries		Practical skills for planning and carrying out the fieldwork for underwater nature mapping	Scientists, students
France (note: references to annexes and figures below refer to NSR - see Annex 8)									
SHOM / GG	French metropolitan waters (data available on other seas)	BDBS, BDTOPO and BDPS databases	Data acquisitions since XIXe century; the most part is digitized	**Subtidal : multibeam,** echosounding, lead-line survey **Intertidal** (not complete): topography, photogrammetry	Bathymetric and topographic measurements	All depth range	Bathymetric plotting sheet and point geo-referenced data base (Annex 1- figure 1)		Drawing up of navigation charts, scientists

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
SHOM and partly IFREMER/SISMER (Bellouis Michel)	French metropolitan waters (Annex 1- figure 2 and 3) (data available on others seas)	BDSIGMA (SHOM), SEXTANT data server (IFREMER)	French metropolitan waters digitized since 2000	Manual interpretation resulting from BDBS, BDTOPO and BDPS data bases	Isobaths (navigation safe)	All depth range	Geo-referenced isobaths (5, 10, 20, 30, 50, 100, 200 m) and polygons		Coastal managers and scientists
IFREMER (Populus Jacques)	Tidal areas (scarce) (Annex 2 figure 1)	LIDAR	2002–2003	Topographic Lidar	Topography	Tidal areas	Geo-referenced data base, isohypse, gridded DTM (Annex 2 photo 1)		Coastal managers and scientists
CETE Normandie Centre (P. Guillopé)	Atlantic coastline (Annex 3- figure 1)	Ortho littorale	2000–2002	Aerial photography	Color digital orthophotos	Tidal areas	Color digital orthophotos (available on a website) (Annex 3- photo 1)		Coastal managers and scientists
IFREMER/SISMER (Moussa Éric)	French EEZ off the continental shelf (data available on others seas) (Annex 4)	IFREMER/SISMER Data Centre	Since 1969	Multibeam bathymetry	Bathymetry, physical habitat	Deep waters	Metadata and data, maps and grids		Drawing up of navigation charts, scientists
			Since 1991	Bottom imagery					
			Since 2002	Seismic					
Various: CNEXO, BRGM, Universities	French continental shelf, subtidal zones (Annex 5 figures 1, 2 & 3)	Various	Since 1960	Grab samples, coring, Vertical echosounder, submarine photography	Sedimentologic maps, low scale maps geo-referenced on vector form	Tidal area to 200 m	Maps 1/25000 to 1/500000 scale	local	Various
IFREMER (Augris Claude)	French continental shelf, subtidal zones (Annex 5 figures 1, 2 & 3, Annex 6 figures 1,2 & 3)	Geologic synthesis on the French continental shelf	Since 1982	Sidescan, multibeam imagery, seismic, submarine video, coring, grab samples	Sedimentologic and bedform dynamic mapping	5-30m	Maps 1/15000 to 1/100000 scale	local	Various
					Not completely interpreted	5-200 m	Publications	local	Various
SHOM (Garlan Thierry)	French coastal zone (including intertidal areas)	Maps G project	Since 1991	Sidescan, multibeam imagery, seismic, grab samples, old lead observations, cores	Sedimentologic and bedform dynamic mapping	Tidal area to 50 m	Annex 7 figure 1	local	Fishermen

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Various : Universities, Marine laboratories, IFREMER Guillaumont Brigitte	Low scale maps: French territorial waters (not complete); High scale maps (REBENT): intertidal and shallow bottom (Annexe 8, Figure 1 to 6); Mediterranean coast inventory is under developement	Various, IFREMER REBENT project	Data acquisition since 1960, first Rebent digitized product: 2003 for Brittany ; national Rebent planning is under development	Low scale and old data: grab and dredges samples; submarine video; photographs; Current high scale mapping: (REBENT) based on acoustic imagery; Orthophotographs; DTM; ground-truthing.	Biological and sedimentological samples photographs, maps of biocenosis	Low scale data: 10m to 200m ; High scale data: Tidal area to 30-50m.	Maps, publications, web site REBENT (http://www.ifremer.fr/rebent/): digitization and synthesis of old data (low scale, territorial sea) high scale mapping of biocenosis, geo-refererenced maps and databases	local EUNIS (REBENT)	Coastal managers and scientists (modelling and long term changes)
Germany									
To be compiled (Dieter Boedecker)									
Latvia									
To be compiled (c/o Andris Andrushaitis)									
Lithuania									
The same status as in the last year (after S. Olenin)									
Norway									
Institute of Marine Research, odd.aksel.bergstad@imr.no	Mid-Atlantic Ridge	MarEco	2004	Multibeam acoustics, backskatter ROV, AUV, Trawl, Long line, plancton samplers, Ctd etc.	Plancton, Fish, Epifauna, Bathymetrics, oceanography, videos, pictures	Investigations of the marine life at the Midt-Atlantic Ridge			Research and management
Institute of Marine Research, jan.helge.fossaa@imr.no	Norway	Mapping of coldwater corals	Ongoing	Acoustics, ROV	Distribution map,	Mapping of distribution on ccoldwater corals. Status of the reefs	Internal repports		Research and management
Directorate of Nature Management, postmottak@dirnat.no	Norway	Mapping of costal biodiversity	2004	ROV, Modeling of wawe exposure, analysis of available data	Local habitat maps	Pilot studies ti test Directorate of Nature Managements' guidlines on mapping of costal marine biodiversity	Repport to the Directorate of Nature Management (2004 (In Norwegian)	EUNIS classification for some areas	Management
Poland									

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
Maritime Institute in Gdansk; Elzbieta Niemkiewicz	Poland	Natural valuation of the Polish Baltic Sea Protected Areas HELCOM BSPA	Date of work – 1996–1999. Reporting in publication – 2000.	Video film documentation; hydrological and biological measurements of sea water and sea bottom , scuba diving, underwater photography	Depth range – to 10 m; Purpose of project – the qualification of aims and ways of protection of Slowinski National Park, Nadmorski Landscape Park and Nature Reserve Kepa Redlowska	Three-volume monograph with maps of area's natural values, threats and proposal for nature conservation: Kruk-Dowgiallo L., Osowiecki A. and Zmudzinski L. 2000. Natural valuation of the marine parts of the HELCOM Baltic Sea Protected Areas in the Pomeranian voivodship. CBM PAN	National, and Regional Administration Union	hydrological and biological habitat, photographic documentation	Ministry of Environment; Ministry of Scientific Research and Information Technology; The Voivodship Fund for Environmental Protection and Water Management; Regional Administration Union; landscape park's administration
Russia									
To be compiled (no identified expert yet)									
Sweden									
To be compiled (by Jacob Hagberg)									
United Kingdom									
JNCC, Neil Golding	NW Irish Sea	Irish Sea Pilot; marine landscape classification	completed June 2003, Reporting March 2004	AGDS, Multibeam, Drop down video/stills, grabs	RoxAnn datasets, bathymetry, dvd video/stills, species list from grabs	Survey of the (Irish) Sea Mounds in the NW Irish Sea, to biologically validate the marine landscape classification work for the Irish Sea Pilot. Carried out under contract by Matthew Service at DARDNI	Survey report included as Appendix II in Golding et al, 2004. The Irish Sea Pilot: Report on the development of a marine landscape classification for the Irish Sea. JNCC Peterborough	local and UK National Marine Habitat Classification	environmental managers/spatial planning
JNCC, Neil Golding	NW / W of Anglesey (Irish Sea)	Irish Sea Pilot; marine landscape classification	completed July 2003, Reporting March 2004	Sidescan, AGDS, Towed video/stills, grabs	QTC View datasets, sidescan mosaics, dvd video/stills, species list from grabs	Survey to biologically validate the proposed marine landscapes off the welsh coast in the Irish Sea. Carried out under contract by Jim Bennell/Ivor Rees at SOS, Bangor	Survey report included as Appendix I in Golding et al, 2004. The Irish Sea Pilot: Report on the development of a marine landscape classification for the Irish Sea. JNCC Peterborough	local and UK National Marine Habitat Classification	environmental managers/spatial planning

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
CEFAS, David Righton	"North West Riff", south-western end of Dogger Bank in the North Sea.	Spatial and temporal interactions of predators and their prey (MF0317)	Started April 1999, Final report due April 2004.	CTD profiling Sidescan AGDS Plankton sampling Trawls Dredges Grabs Acoustic fish detection	Sampling metadata Bathymetry (line) Georeferenced sidescan Georeferenced AGDS Plankton fauna Demersal fish assemblages Benthic epifauna Still Photo's Particle size analyses Temperature and salinity profiles Sediment description	Subtask within overall project: Assessment of sandeel ecology, abundance and spatial distribution with reference to their physical (15-80 metres depth) and biological environment	Report for ICES Study Group to Evaluate the Effects of Multispecies Interactions (SGEEMI) 2001	Standard plankton, invertebrate and fish taxonomy texts Folk & Wentworth (sediments) Local (seabed description based on acoustic, physical & biotic information)	Defra EU NGO's Industry Scientific community
							K. Turner, S. Mackinson and D. Righton. Abundance of sandeels on the Dogger Bank: variability evaluation of acoustics and fishing methods. Fisheries Research - in review		
							S. Mackinson, S. Freeman, R. Flatt. 2004. Diel patterns in the habitat utilisation of sandeels revealed using integrated acoustic surveys, JEMBE - in press.		
							S.Mackinson, S.Freeman, R.Flatt, B.Meadows. 2004. Improved acoustic surveys that save time and money:integrating fisheries and ground-discrimination. JEMBE - in press.		

Organisation, name of contact person*	Geographical coverage (country, region)*	Project title	Date of work, expected year of reporting*	Techniques used (e.g., acoustics, ground-truthing)*	Datasets generated (e.g., bathymetry, physical habitat, biological, photographic)*	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
							E. Bell. 2004 Sandeel abundance on the south west Dogger Bank 2000-2003 : UK data.		
							NB: note that these are specific to the subtask, and do not encompass the range of publications resulting from the entire project		
DARD/QUB/JNCC: Matthew Service / Annika Mitchell	UK, Northern Ireland / Scotland, Blackstone Banks	N Ireland Inshore Habitat Mapping Project/ MINCH Project/ Irish Sea Pilot	2003. Reported March 2004.	Multibeam echosounder, RoxAnn AGDS, towed underwater video	Physical and biological habitat descriptions and distributions, photographic/video datasets, bathymetry	Characterisation of reef habitat (20-100m depth range)	Report to JNCC, GIS project	JNCC (MNCR) 97.06 and JNCC (MNCR) 03.02	JNCC
DARD/QUB/JNCC/SNH: Matthew Service / Annika Mitchell	UK, Northern Ireland / Scotland, Stanton Banks	MINCH Project	2003. Reported December 2003 and March 2004.	Multibeam echosounder, RoxAnn AGDS, towed underwater video	Physical and biological habitat descriptions and distributions, photographic/video datasets, bathymetry	Characterisation of reef habitat (30-120m depth range)	Report to SNH (as part of MINCH Project), later report to JNCC, GIS project	JNCC (MNCR) 97.06 and JNCC (MNCR) 03.02	SNH / JNCC
Scottish Association for Marine Science. Craig Brown.	Firth of Lorne	UK National AGDS workshop	Workshop Sept 2003. Report 2004	RoxAnn AGDS, underwater video, sidescan sonar	RoxAnn data sets, sidescan sonar mosaic, Life-form maps.	Practical AGDS workshop comparing final habitat maps produced from a number of surveys carried out by a number of research/survey teams.	Workshop report for general circulation.	modified JNCC (MNCR) 97.06 and JNCC (MNCR) 03.02	Environmental managers

Annex 5 Habitat mapping on German Bank, Gulf of Maine

Brian J. Todd, Vladimir E. Kostylev, Geological Survey of Canada (Atlantic)
Page C. Valentine, US Geological Survey
Oddvar Longva, Norwegian Geological Survey

The worldwide increased interest in the management and conservation of marine environments and species has stimulated efforts to produce large-scale geological maps of the sea floor. By linking to biological studies, we develop predictive models of geoscience controls on benthic habitat distribution. The term "habitat" is widely used and means different things to different people. For clarity, we define habitats as spatially recognizable areas where the physical, chemical and/or biological environment is distinctly different from surrounding environments (Kostylev *et al*., 1999).

There are two levels of habitat mapping rationale, the first being the global view. There is now global recognition of the utility and importance of advanced sea floor mapping in providing the fundamental framework for ocean management in the 21st century. National mapping programs are needed to systematically map our continental margins to provide required knowledge for sustainable resource development. Major human activities in coastal and marine environments require knowledge of the sea floor for successful management. Without a systematic mapping program, governments lack the most important tool used to sustain our resources.

The second level of habitat mapping rationale focuses on specific regional issues. In Canada, the federal Department of Fisheries and Oceans is charged with setting fishing quotas and enforcing the laws governing the fishery. On German Bank (Figure 1), the scallop and lobster fisheries generate tens of millions of dollars annually and are a vital sector of the economy of the province of Nova Scotia. However, these fisheries compete both temporally and spatially for the same fishing grounds, and this conflict has to be solved and the fisheries responsibly managed. The Canadian government supports sea floor mapping as the necessary first step to sustain these resources.

During the course of the German Bank mapping project, our objective is to produce a suite of four sea floor maps, similar to previous work on Browns Bank in the Gulf of Maine (Todd *et al*., 1999; Pickrill and Todd, 2003). Two data-based maps, topography and backscatter strength, are derived from multibeam sonar data. Two interpreted, or value-added, maps, are surficial geology and benthic habitat. These latter two maps are based on targeted groundtruth information. Groundtruth surveys are designed and conducted using the topography and backscatter maps to optimize the seagoing survey effort.

German Bank is located in the Gulf of Maine, which is a semi-enclosed sea under the jurisdiction of Canada and the United States. The 165,000 square kilometres of the Gulf have been identified as one of the world's most dynamic, productive, and important ocean systems, often called "a sea within a sea". The Gulf of Maine sea floor is rough, with water depths ranging from less than 10 metres to 377 metres in the deepest basin (Figure 1).

Glaciers have shaped the recent geological history of the Gulf of Maine. At the last glacial maximum, the Gulf was filled with grounded ice. The ice sheet terminated on Georges and Browns Banks, and an ice stream exited through Northeast Channel. By 17 000 years before present, grounded ice had retreated into the Gulf of Maine. Thinning of the ice sheet formed ice shelves and the remainder of the Gulf was filled with sea ice and icebergs. As the ice sheet retreated west, sea level was lower, and German Bank was subaerial. As time passed, German Bank was inundated, and the remnant glacial geomorphology that we map today was modified in response to the oceanographic conditions developed in the Gulf of Maine.

The German Bank survey encompasses 5300 square kilometres (Figure 2). On the multibeam image, the shallowest areas of German Bank are shown in red and are 10 to 25 metres deep. Water depth increases to the west, with violet indicating depths greater than 225 metres. Prior to our study, little historical geophysical or geological groundtruth information had been collected on German Bank. Therefore, subsequent to the multibeam survey, we collected extensive groundtruth data, shown in Figure 3 by the red lines indicating the track of the survey vessels; photograph and sediment sample locations are shown by the blue dots.

The multibeam bathymetric data hold a wealth of topographic information. Patterns and details can be readily seen that were not detectable on the historic bathymetric compilation. For example, in the central part of German Bank, the sea floor is rough and consists of metasedimentary rocks intruded by granitoid plutons. Superimposed on this rough terrain is a suite of moraines striking approximately northeast-southwest (Figure 4).

The recessional moraines are lobate in plan view, are roughly parallel, and extend at least 70 kilometres across the bank through the complete water depth range. The other, prominent moraines on the bank are linear in plan view, parallel, closely-spaced and hundreds of meters to kilometres in length. These De Geer moraines occur in distinct fields, predominantly in shallower water. The De Geer moraines on German Bank are 1 to 6 metres in height. Although the spacing between individual moraines varies between 50 and 500 metres, some moraine fields demonstrate a remarkably even spacing of 100 metres. The seismic reflection profile and associated sidescan sonar image indicate that the De Geer moraine crests are boulder-covered, with finer-grained sediment in the troughs (Figure 5). Sea floor video imagery shows pebbles, cobbles, shell fragments and horse mussels in the troughs with ridges composed of cobbles and boulders.

Characterizing, classifying and mapping habitats in the Gulf of Maine has lead us to develop the Northeastern North American Marine Sublittoral habitat classification, or NENAMS (Valentine *et al*., in press). This habitat classification scheme is designed to be a template for a database that will allow the habitat characteristics of a site to be easily entered into a computer. The scheme emphasizes the importance of seabed substrate type, substrate dynamics, and seabed physical and biological complexity in characterizing and naming sublittoral habitats. The habitat database can be searched for any habitat type or characteristic, and it can provide habitat information for areas of interest to scientists and managers. We expect that a well-designed regional habitat classification can be expanded to incorporate new kinds of observations or expanded into other environments by incorporating applicable terminology.

The NENAMS habitat classification scheme, designed to describe and classify habitats in terms of geological, biological and oceanographic attributes, is being tested in its first application to the German Bank mapping project. Our work plan between now and 2006 is to complete habitat mapping in the 40% of the Canadian portion of the Gulf of Maine that has undergone multibeam sonar and groundtruth surveying (Figure 6). All maps will be published by the Geological Survey of Canada and will be available in geospatial, digital format.

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Roworth, E., and Signell, R.P. 1998. Construction of digital bathymetry for the Gulf of Maine. United States Geological Survey Open File 98–801, http://pubs.usgs.gov/of/of98-801.

Todd, B.J., Fader, G.B.J., Courtney, R.C., and Pickrill, R.A. 1999.Quaternary geology and surficial sediment processes, Browns Bank, Scotian Shelf, based on multibeam bathymetry. Marine Geology, 162: 165–214.

Valentine, P.C., Todd, B.J., and Kostylev, V.E. In press. Classification of marine sublittoral habitats with application to the northeastern North America region. *In* Benthic habitats and the effects of fishing, American Fisheries Society.

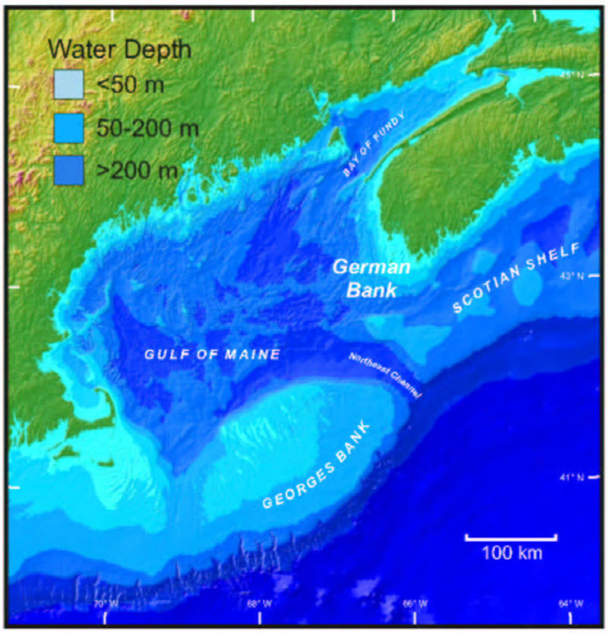


Figure 1. Location of German Bank in the Gulf of Maine. Digital elevation model from Roworth and Signell (1998).

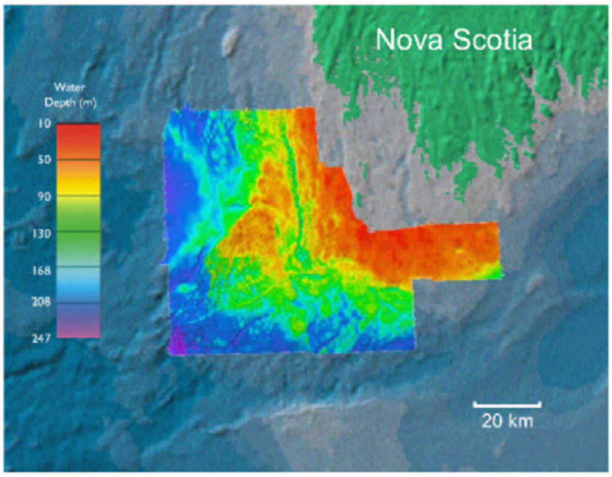


Figure 2. Multibeam topography of German Bank with a horizontal resolution of 5 metres.

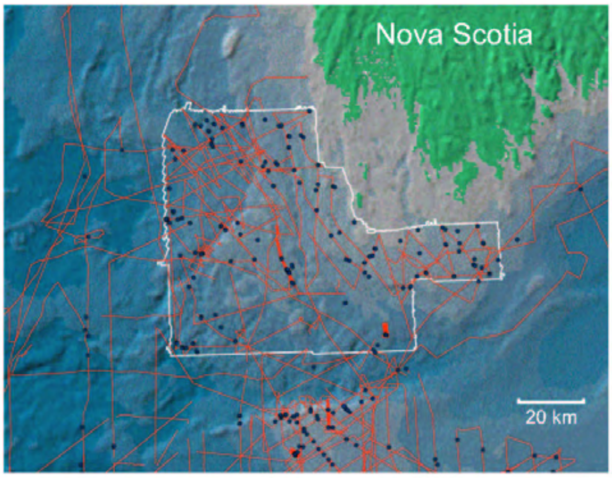


Figure 3. Geophysical survey lines and geological/biological sample stations (blue dots) on German Bank.

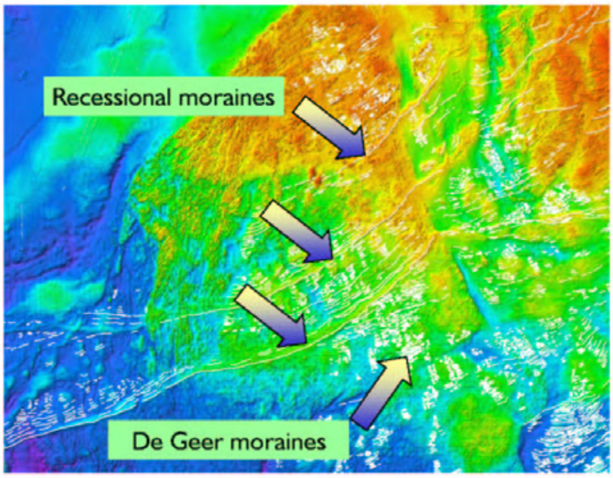


Figure 4. Multibeam topography of German Bank highlighting recessional and De Geer moraines.

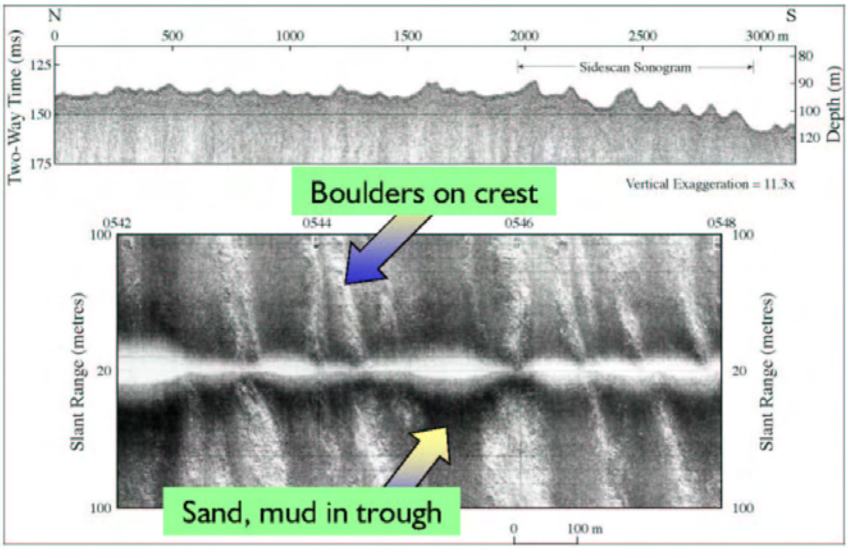


Figure 5. Seismic reflection profile and associated sidescan sonar image of De Geer moraines.

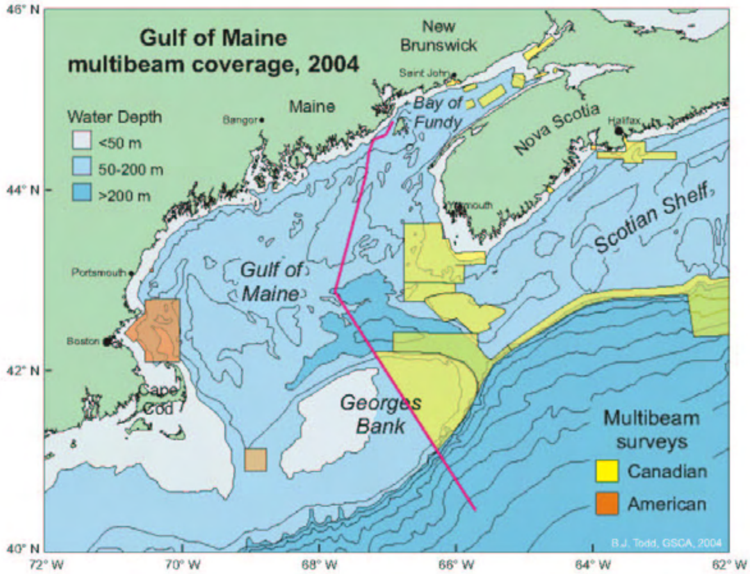


Figure 6. Gulf of Maine sea floor mapping coverage, 2004.

Annex 6 Development of a framework for Mapping European Seabed Habitats (MESH)

JNCC will lead an EU Interreg-funded international marine habitat mapping programme entitled 'Development of a framework for **M**apping **E**uropean **S**eabed **H**abitats', or **MESH** for short, which will start in spring 2004 and last for 3 years[4]. MESH has twelve partners in the UK, Ireland, the Netherlands, Belgium and France and aims to produce seabed habitat maps covering the marine waters of north-west Europe, together with the development of international standards for seabed mapping. Further details of the project are given below.

Duration

May 2003–April 2007 (including preparation phase)

Background

The seas around north-west Europe support an exceptionally wide range of seabed habitats and rich biodiversity. These provide important food resources (fish, shellfish), contribute to essential ecosystem functioning (such as nutrient recycling) and yield valuable natural resources (oil, gas, aggregates). In addition the seabed is subject to increasing pressures from new developments, such as for renewable energy (e.g., wind-farms) and coastal developments for leisure activities and coastal defences.

These multiple uses bring ever-growing pressures on our seas and coasts, leading to increased risk of conflict between users and a greater potential for degradation of the marine environment and the essential physical, chemical and biological processes that maintain our marine ecosystem. We are responding to this challenge through recognition of the need for much improved integrated spatial planning for our seas (where traditionally planning has been very piecemeal or sectoral), as reflected by the new requirement for Strategic Environmental Assessments (SEAs) and issues raised recently within the developing EU Marine Strategy, by the OSPAR Commission and by Governments (e.g., the UK's Marine Stewardship Report). Additionally there are new and increasing international commitments (from the EC Habitats Directive and OSPAR) to protect certain marine habitats, including through the designation of a network of marine protected areas, whilst the EC Water Framework Directive and OSPAR require periodic assessment of ecosystem health, including its seabed biological communities. The assessment of coastal sensitivity to oil spills is currently hampered by the lack of proper data on habitats, as has been shown by the recent *Prestige* case in France.

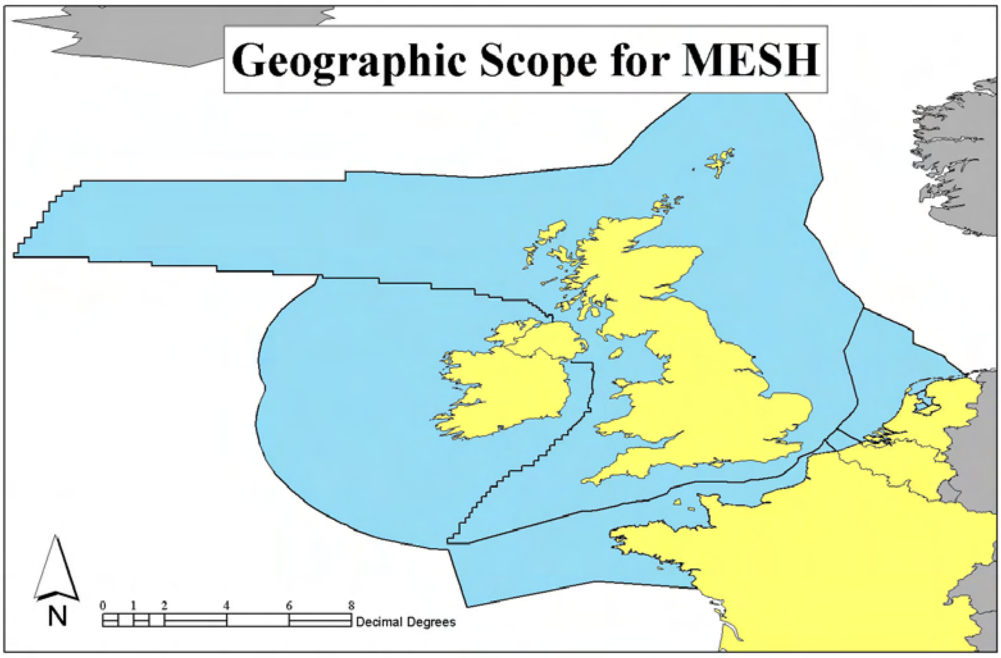
All this creates a substantial demand for information about intertidal and seabed habitats, but is set against a background of patchy, inconsistent and poorly collated information on their distribution, extent and quality. There are no national programmes in the north-west Europe region (except in France) which collate such information and the information which is available is difficult to access, making very poor use of data which are expensive to collect. The recent increase in demand, coupled with advances in remote-sensing technologies over the past ten years, has led to a burgeoning of seabed mapping studies. These are undertaken using a variety of techniques, for a range of end needs (e.g., fisheries, commercial, nature conservation) and at various scales. The lack of international standards for these studies means the resulting data cannot readily be compared or aggregated and leads to an absence of regional, national and international perspectives on the seabed resource in spatial planning and decision-making.

MESH aims to address these key issues, as detailed below.

Geographic scope

The project will cover the sea areas mapped in blue. Boundaries are country EEZs (or equivalent), except France, where the southern boundary relates to southern limit of the Interreg North-West Europe area.

[4] Initiation of the project is subject to finalisation of budget and contractual arrangements with Interreg IIIb North-West Europe Secretariat.



Key aims of MESH

MESH will address these issues in the following key ways:

- It will compile available seabed habitat mapping information across north-west Europe and harmonise it according to European habitat classification schemes (the European Environment Agency's EUNIS system and the EC Habitats Directive types) to provide the first seabed habitat maps for north-west Europe (see map).
- Because the available information will be of variable quality and patchy in nature, habitat modelling will be developed to predict habitat distribution for unsampled areas, from the more widely available geophysical and hydrographic data. The final maps will be presented with confidence ratings so that end-users can determine their adequacy for their decision-making and future survey effort can be strategically directed.
- A set of internationally agreed protocols and standards for habitat mapping will be developed, drawing upon best available expertise across Europe and elsewhere, to help ensure that future mapping programmes yield quality assured data that can be readily exchanged and aggregated to further improve the initial maps. The protocols will be tested through a range of field-testing scenarios involving trans-national co-operation to ensure they are robust and the results repeatable.
- Both the protocols and the habitat maps will be made available via state of the art Internet-based GIS (Geographical Information Systems), providing ready access to the information for a wide range of end-users at local, regional, national and international levels (e.g., spatial planners and managers; governments and other regulatory authorities, research institutions, educational establishments).
- The wide spectrum of potential end-users will be engaged from the start of the project to better understand their end needs, to encourage the supply of relevant data and to encourage the improved use of the mapping information in spatial planning, management issues and for environmental protection. This network of stakeholders will be valuable in helping to forge strategies within each country for the maintenance and further improvement of the seabed maps beyond the end this three-year project.

A strong Partnership of highly skilled and experienced organisations has been developed to deliver this challenging project. The Partnership covers all five countries in the Interreg IIIb North-West Europe area, bringing with it a balanced mix of skills including scientific and technical habitat mapping skills, national data collation and management expertise and experience in the use of habitat mapping in management and regulatory frameworks. This blend of expertise from scientific/technical through to management and policy, with a focus on regional, national and international level delivery is felt to be essential to effectively deliver the required end products in a readily useable format.

Partnership

UK	Joint Nature Conservation Committee (JNCC)
BE	University of Gent
FR	Ifremer
IRE	Marine Institute
NL	Alterra-Texel
NL	TNO Environment, Energy and Process Innovation
UK	Centre for Environment, Fisheries and Aquaculture Science (CEFAS)
UK	Department for Agriculture and Rural Development, Northern Ireland (DARD)
UK	English Nature
UK	Envision Mapping Ltd
UK	National Museums and Galleries of Wales (NMGW)
UK	Natural Environment Research Council (British Geological Survey) (BGS)

Outputs from MESH

- The first collated and harmonised map of seabed habitats for the north-west Europe INTERREG-IIIB Area, presented in a Geographical Information System (GIS) according to the European Environment Agency's European EUNIS habitat classification system and the EC Habitats Directive types.
- Accompanying confidence maps, indicating the quality of mapping information in relation to its accuracy and precision at different scales of resolution.
- A meta-database of seabed mapping studies for north-west Europe, holding details on the location of each study, the mapping techniques employed and the range of data and end products generated.
- The first large-scale evaluation of the practical application of the EEA's EUNIS habitat classification and recommendations for its modification or improvement.
- A set of internationally agreed protocols and standards for marine habitat mapping. This will include guidance on mapping strategies, standards for undertaking remote-sensing and ground-truthing surveys for intertidal and subtidal mapping using a variety of techniques, and protocols for data storage, interpretation and presentation.
- A series of new mapping studies which test, evaluate and help improve the mapping protocols and standards.
- Models for the prediction of habitat type, based on physical and hydrographic information within different habitat areas and water depths.
- Case studies which demonstrate the political, economic and environmental use of marine habitat maps for spatial planning and management at local through o international scales.
- A web site providing wide access to the products of the project, including interactive GIS seabed maps for north-west Europe.
- National networks of habitat mapping practitioners and end-users in management, regulatory and planning authorities.
- A framework within each country for the continued collation and improvement of habitat maps at national level and their compilation and aggregation at an international level.

Habitat Mapping

National Status Report, France

Preliminary Report, Mars 2004

B. GUILLAUMONT, A. EHRHOLD, C. AUGRIS, É. MOUSSAT, J. POPULUS

Ifremer, Centre de Brest
Technopôle Brest-Iroise
BP 70
29280 PLOUZANÉ

This report is a preliminary report about habitat mapping and physical data commonly used in habitat mapping sequence. At the present time, it is not exhaustive. Only benthic habitats of metropolitan waters have been investigated.
The biological data inventory is well advanced in Brittany. On the other coasts, namely the channel and atlantic ones, only the main data are shown. A biological data inventory is starting along the mediterranean coast where a lot of maps are available concerning mainly posidonia beds.

Organisation, name of contact person	Geographical coverage (country, region)	Project title (code)	Date of work, expected year of reporting	Techniques used (e.g. acoustics, ground-truthing)	Datasets generated (e.g. bathymetry, physical habitat, biological, photographic)	Brief description of work (including depth range)	Outputs: Reports, publications, maps, reference lists	Classification used; local (within project), national (state), EUNIS	Targeted end-users
SHOM / GG	French metropolitan waters (data available on other seas)	BDBS, BDTOPO and BDPS databases	Data acquisitions since XIXe century; the most part is digitized	**Subtidal**: multibeam, echosounding, lead-line survey **Intertidal** (not complete): topography photogrammetry	Bathymetric and topographic measurements	All depth range	Bathymetric plotting sheet and point geo-referenced data base Annex 1- figure 1		Drawing up of navigation charts, scientists
SHOM and partly **IFREMER/SISMER** Bellouis Michel	French metropolitan waters Annex 1- figure 2 and 3 (data available on others seas)	BDSIGMA (SHOM), SEXTANT data server (IFREMER)	French metropolitan waters digitized since 2000	Manual interpretation resulting from BDBS, BDTOPO and BDPS data bases	Isobaths (navigation safe)	All depth range	Geo-referenced isobaths (5, 10, 20, 30, 50, 100, 200 m) and polygons		Coastal managers and scientists
IFREMER Populus Jacques	Tidal areas (scarce) Annex 2 figure 1	LIDAR	2002-2003	Topographic Lidar	Topography	Tidal areas	Geo-referenced data base, isohypse, gridded DTM Annex 2 photo 1		Coastal managers and scientists
CETE Normandie Centre P. Guillopé	Atlantic coastline Annex 3- figure 1	Ortho littorale	2000-2002	Aerial photography	Color digital orthophotos	Tidal areas	Color digital orthophotos (available on a website) Annex 3- photo 1		Coastal managers and scientists
IFREMER/SISMER Moussa Éric	French EEZ off the continental shelf (data available on others seas) Annex 4	IFREMER/SISMER Data Centre	Since 1969	Multibeam bathymetry	Bathymetry, physical habitat	Deep waters	Metadata and data, maps and grids		Drawing up of navigation charts, scientists
			Since 1991	Bottom imagery					
			Since 2002	Seismic					
Various: CNEXO, BRGM, Universities,	French continental shelf, subtidal zones Annex 5 figures 1, 2 & 3	Various	Since 1960	Grab samples, coring, Vertical echosounder, submarine photography	Sedimentologic maps, low scale maps geo-referenced on vector form	Tidal area to 200 m	Maps 1/25000 to 1/500000 scale	local	Various
IFREMER Augris Claude	French continental shelf, subtidal zones Annex 5 figures 1, 2 & 3 Annex 6 figures 1,2 & 3	Geologic synthesis on the french continental shelf	Since 1982	Sidescan, multibeam imagery, seismic, submarine video, coring, grab samples	Sedimentologic and bedform dynamic mapping	5-30m	Maps 1/15000 to 1/100000 scale	local	Various
					Not completely interpreted	5-200 m	Publications	local	Various

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SHOM Garlan Thierry	French coastal zone (including intertidal areas)	Maps G project	Since 1991	Sidescan, multibeam imagery, seismic, grab samples, old lead observations, cores	Sedimentologic and bedform dynamic mapping	Tidal area to 50 m	Annex 7 figure 1	local	Fishermen
Various : Universities, Marine laboratories, IFREMER Guillaumont Brigitte	**Low scale maps:** French territorial waters (not complete) ; **High scale maps (REBENT):** intertidal and shallow bottom (Annexe 8, Figure 1 to 6); Mediterranean coast inventory is under developement	Various, IFREMER REBENT project	Data acquisition since 1960, first Rebent digitized product: 2003 for Brittany ; national Rebent planning is under development	**Low scale and old data:** grab and dredges samples; submarine video; photographs; **Current high scale mapping:** (REBENT) based on acoustic imagery; Orthophotographs; DTM; ground-truthing	Biological and sedimentological samples photographs, maps of biocenosis	**Low scale data:** 10m to 200m ; **High scale data:** Tidal area to 30-50m	Maps, publications, web site REBENT (http://www.ifremer.fr/rebent/) : digitization and synthesis of old data (low scale, territorial sea) high scale mapping of biocenosis, geo-refererenced maps and databases	local EUNIS (REBENT)	Coastal managers and scientists (modelling and long term changes),

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Annex 1

Figure 1: example of SHOM* BDBS data

* Address: EPSHOM (Établissement Principal du Service Hydrographique Océanographique de la Marine): 13 rue du Chatellier, BP30316, 29603 BREST CEDEX

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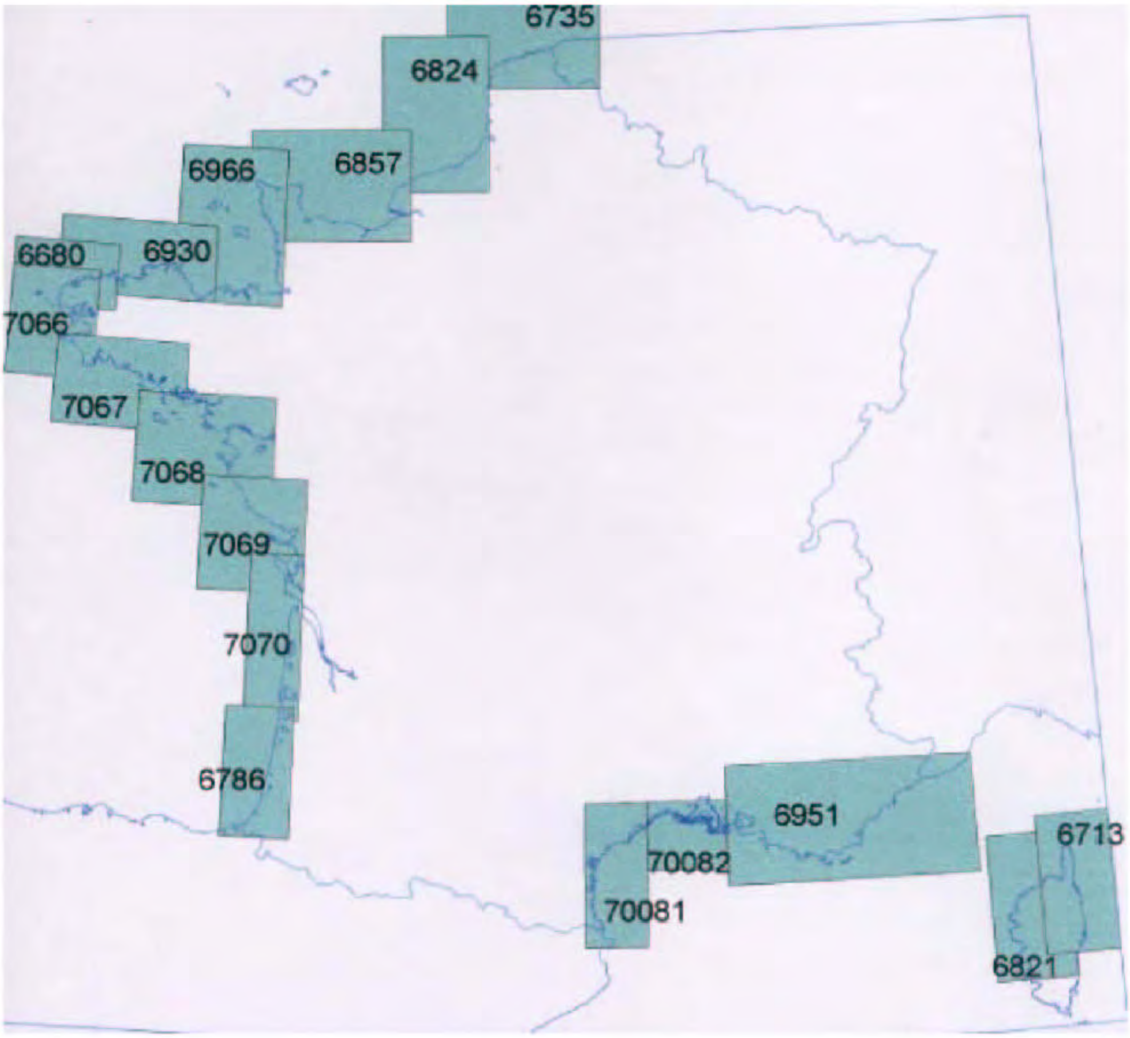
Annex 1

Figure 2: geo-referenced isobaths and bathymetric polygons (SHOM Marine charts 1 : 150 000)



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Annex 1

Figure 3: geo-referenced isobaths and bathymetric polygons (SHOM marine charts 1: 50 000)

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Annex 2

Figure 1: topographic Lidar coverage
Tidal area, Brittany, France
J. Populus, Ifremer

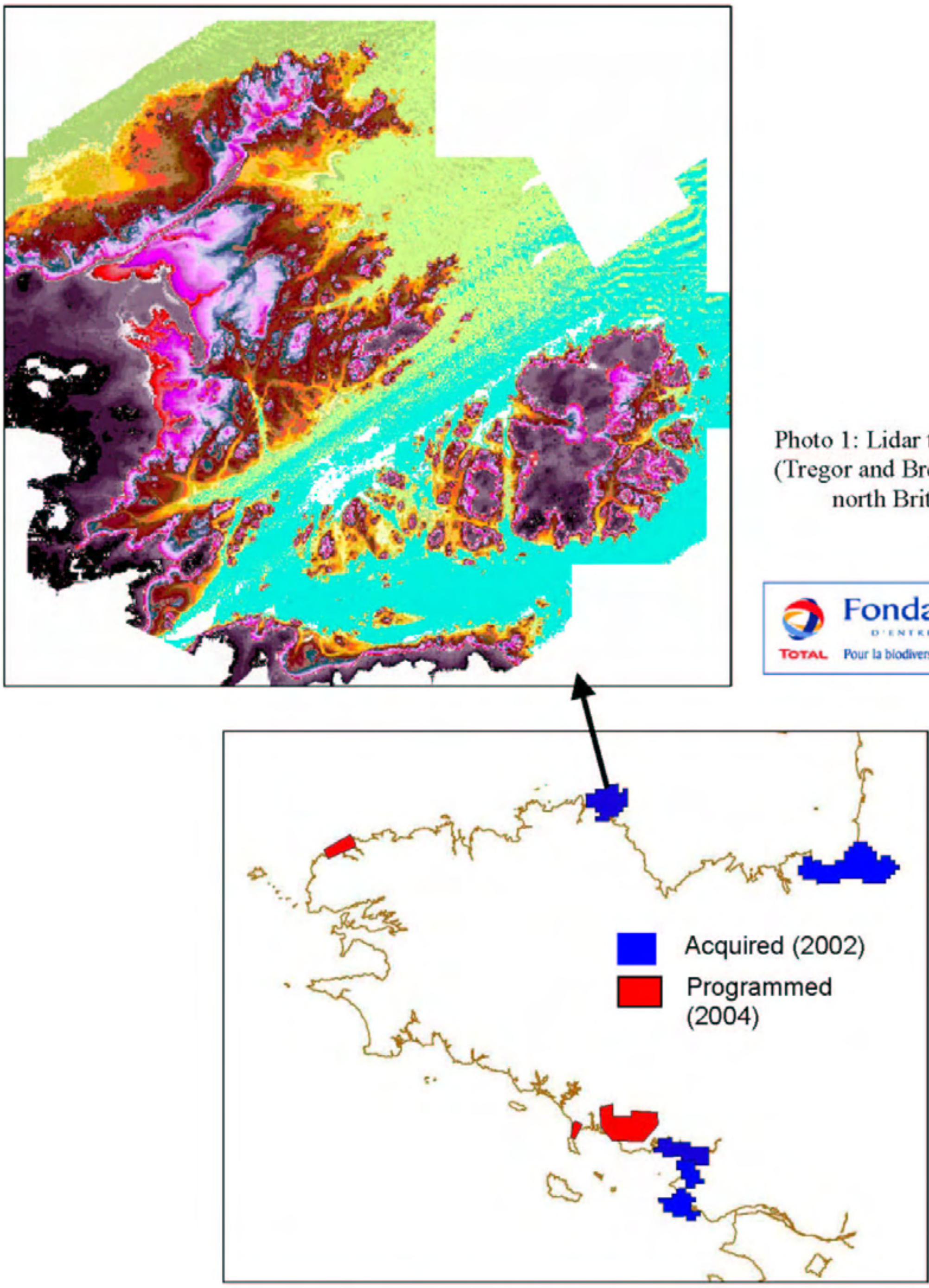

Photo 1: Lidar topography (Tregor and Brehat island, north Brittany)

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Annex 3

« Ortho littorale » project

http://siglittoral.3ct.com/

Photo 1 :Orthophoto (Tregor and Brehat island, north Brittany) © ortholittorale 2000

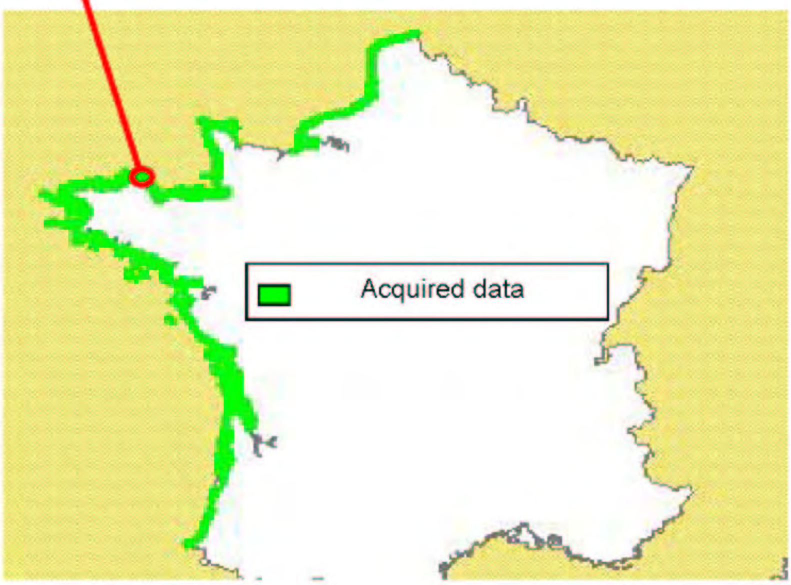

Fig 1 « Ortho littorale » aerial survey

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Annex 4

Data Centre IFREMER/SISMER

Éric Moussat
Centre IFREMER de Brest
BP 70
29280 Plouzané – (France)

1. Data Centre description

SISMER (Systèmes d'Informations Scientifiques pour la Mer) Data Centre (www.ifremer.fr/sismer) has the national responsibility of archiving and disseminating :

- National Oceanographic information and catalogues
- and marine in-situ data :
  - National Geophysical Data Bank
  - National Physical and Chemical Data Bank
  - Operational oceanography data centre

Sea cruise information (meta-data) and conventional data collected during national projects are systematically compiled, safeguarded and disseminated. It participates in European and international programmes of long duration and several shorter term national or European projects. Standardised Quality Assurance procedures data formatting and checking, based on IOC and ICES recommendations, are systematically performed on the data archived at SISMER. The data products and services include data and value added gridded fields and maps disseminated on internet and or on Cdrom databases. Future prospects are directed towards the operational management of biological and fisheries data.

2. Oceanographic Information and Catalogues

Directory	Internet address	Comment
ROSCOP/CSR Cruise summary reports	www.ifremer.fr/sismer/catal/campagne/campagna.htm	annual dissemination to ICES, WDCs & JODC (Pacific subset)
EDMED/MEDI Marine Environmental Data Sets	www.ifremer.fr/sismer/catal/base/basea.htm	Sending to BODC for integration in the European directory
SEA-SEARCH	www.sea-search.net/	Oceanographic and Marine Data & Information in Europe

Table I: permanent catalogues fed by SISMER

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3. National Geophysical Data Bank

SISMER (http://www.ifremer.fr/sismer/program/geophys/geow3a.html) archives field geophysical data and calibration parameters collected on board of the research vessels. Data are transmitted directly from the ships by GENAVIR, a subsidiary of IFREMER (CNEXO before 1984), and by the French Polar Institut (Institut Polaire Français Paul Emile Victor, IPEV) under the responsibility of the chief scientists. Data are archived since 1969. Table II shows their content by decades of data collection.

Data Type/Decade	1969-1978	1979-1988	1989-1998	1999-2003
Multibeam bathymetry	13	141	122	73
Vertical Bathymetry	97	145	110	133
Gravity	36	69	102	112
Magnetics	70	108	74	28
Imagery (*)			80	67
Seismic reflection (**)				8

Table II: Surveys archived by time period of the observations

(*) Sonar function of MBES : starting in 1991 ; (**)Low Frequency : starting in 2002

As shown in Fig. 1, data hold by SISMER cover all oceans, continental margins and deep-sea sedimentary basins. More than 12 millions of km2 of seafloor of multibeam echosounder survey are archived. All the French metropolitan Exclusive Economic Zones (EEZ) off the continental shelf is covered. Large parts of the EEZ of the French overseas territories are already covered and their surveys are in progress.

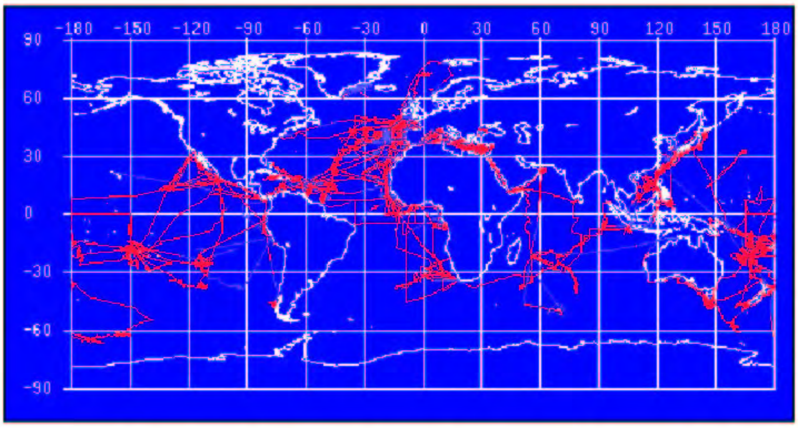

Fig. 1: Space distribution of the archived French multibeam echosounder data (january 2004)

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A series of Quality Checks (QC) related to the following items are applied before archiving at SISMER and for the archiving:

- completeness of data and metadata, data format, time and position of data
- detection of errors (min-max, picks), data consistency (comparison of values at track crosses)

These QC are part of the CARAIBES data processing software of IFREMER. Further information on this software and its conditions of availability, refer to : http://www.ifremer.fr/flotte/equipements_sc/logiciels_embarques/index.html.

Data products (maps and grids) are available on line (fig 2) or on Cdrom databases.

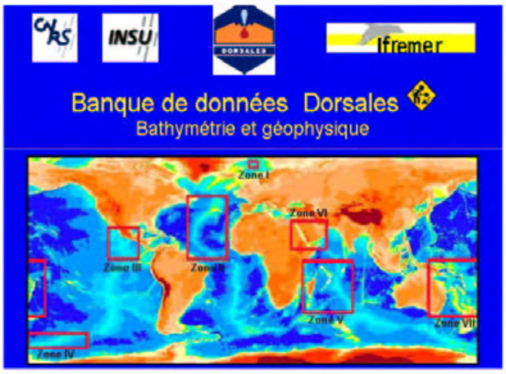


Fig. 2: Maps and gridded fields server from the DORSALES/RIDGE project (http://www.ifremer.fr/sismer/program/dorsale/)

Specific repertories are being developped in the framework of national (Extraplac) and European programs (Euroseismic) : inventory of seismic and bathymetric data on the French Continental Shelf (Extraplac), Seismic and sonar data from the European Seas (Euroseismic : http://www.eu-seased.net/welcome_flash.html).

Other geophysical surveys collected by vessels of other French organizations are described in the cruise summary reports. Data not hold by SISMER can be requested to the chief scientists and their laboratories according to the data dissemination rules of their producers and dataholders.

4. Marine Geological Data Bank

The repository of marine geological samples host by IFREMER in its Centre of Brest and its associated geological data bank managed by the French geological survey (BRGM) have been placed under the entire responsibility of IFREMER in 2003. A new Data Bank is being designed in cooperation with the sedimentologists of the Geosciences Division and will be managed by SISMER. The data bank and repository will offer their ressources to collaborating laboratories and organizations from Britany (University, Hydrographic Office…).

They will act as the main node of the French repositories under the coordination of BRGM.

5. Other data banks

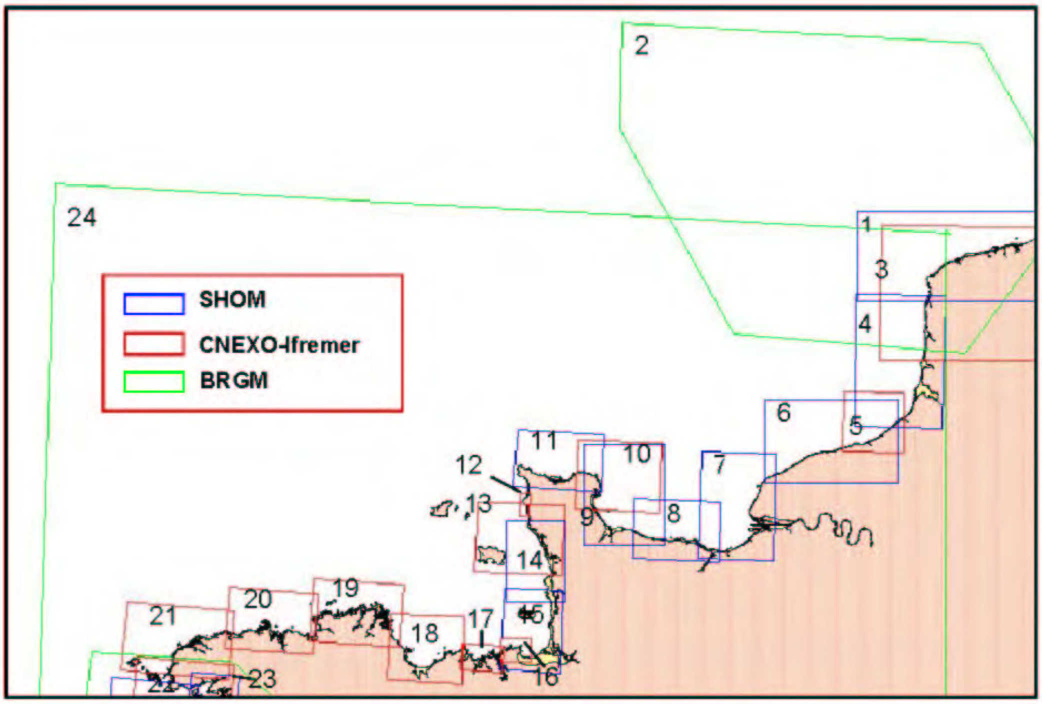
Large data sets of different kind are searchable and can be made available in other relevant databanks of SISMER among which :

- National Physical and Chemical Data Bank (http://www.ifremer.fr/sismer/program/phys/donocepa.htm)
- Operational oceanography data centre (http://www.coriolis.eu.org/coriolis/cdc/)

Annex 5

A. EHRHOLD, Ifremer

Figure 1: sedimentologic and bedform dynamic mapping
Limits of sedimentologic maps on Channel coast



N°	Title	Scale	Authors/Date	Editor/source M: Map R : report
1	Carte G 7323	-	2004	M: Epshom
2	GEOSYNTH project	-	2002	M: BRGM CDROM
3	Carte des formations superficielles sous-marines du Nord-Pas-de-Calais	1/100 000	Augris et al./1995	M: Ifremer
4	Abords sud de Boulogne-sur-Mer - 7416G	1/75 000	Bizien/2000	M: Epshom
5	Carte morpho-sédimentaire entre Dieppe et le Tréport	1/150 000	Augris et al./1993	M: Ifremer
6	Abords de Fecamp et Dieppe - 7417G	1/75 000	in project	M: Epshom
7	Abords du Havre et d'Antifer - 7418G	1/60 000	Laignel et al./1999	M: Epshom
8	De la pointe de la Percée à Ouistreham - 7421G	1/50 000	Ehrhold et al./2004	M: Epshom
9	De la pointe de Barfleur à la pointe de la Percée - 7422G	1/50 000	Auffret et al./1995	M: Epshom
10	Carte sédimentologique sous-marine de St-Vaast-la-Hougue -	1/100 000	Larsonneur/1968	M: CNEXO
11	Abords de Cherbourg - 7120G	1/50 000	Duval et al./2004	M: Epshom
12	Abords de Flamanville	1/15 000	Augris et al./2004	M: Ifremer
13	Carte sédimentologique sous-marine de Carteret	1/100 000	Hommeril/1968	M:CNEXO
14	De la pointe d'Agon au Cap de Carteret - 7157G	1/50 000	in project	M: Epshom
15	Baie du Mont Saint-Michel - 7156G	1/50 000	Ehrhold et al./2004	M: Epshom
16	Carte de répartition de la crépidule et des sédiments superciels	1/25 000	Blanchard et al./1997	M: Ifremer
17	Carte des formations superficielles sous-marines entre le Cap Frehel et St-Malo	1/20 000	Augris et al./2000	M: Ifremer
18	Carte Sédimentologique, atlas de Saint Brieuc	1/100 000	Houlgate/1996	Atlas: Ifremer
19	Carte sédimentologique sous-marine de Perros-Guirec Guingamp	1/100 000	Cressard/1973	M: CNEXO
20	Carte sédimentologique sous-marine de Morlaix	1/100 000	Cressard/1973	M: CNEXO
21	Carte sédimentologique sous-marine de Plabennec	1/100 000	Marec et Hinschberger/1975	M: CNEXO
22	Du Goulet de Brest à Porsall - Ile d'Ouessant - 7149G	1/50 000	Armand/2004	M: Epshom
23	Rade de Brest -7400G	1/25 000	to be published	M: Epshom
24	Carte des sédiments superficiels de la Manche	1/500 000	Vaslet et al./1978	M: BRGM

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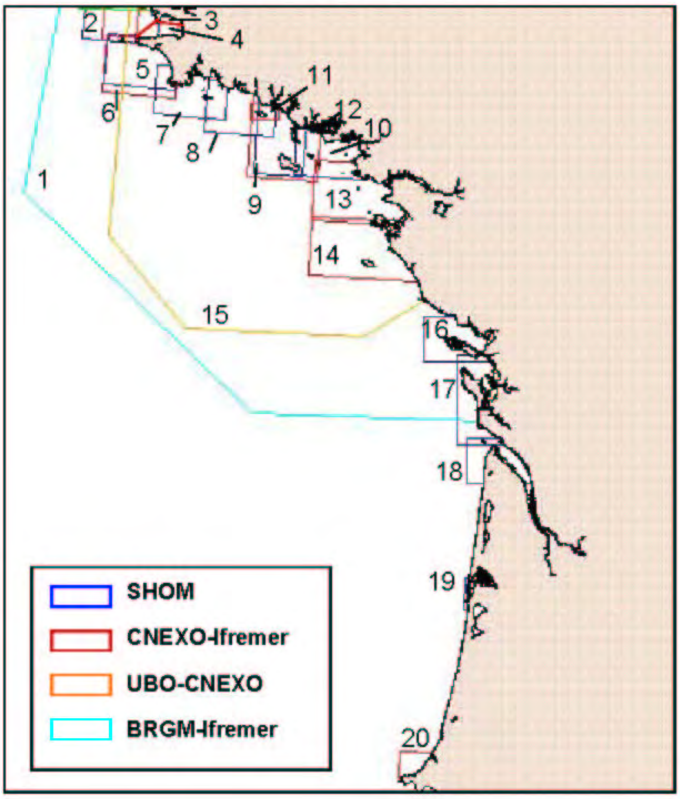
Preliminary report, Avril 2003

Annex 5

A. EHRHOLD, Ifremer

Figure 2: sedimentologic and bedform dynamic mapping
Limits of sedimentologic maps on Atlantic coast



N°	Title	Scale	Authors/Date	Editor/source M: Map R : report
1	Carte des sediments superficiels du plateau continental du Golfe de Gascogne	1/500 000	Lesueur et al./1986	M: BRGM/Ifremer
2	De la pointe de St-Mathieu à la Chaussée de Sein - 7172G	1/50 000	Cordier/2001	M: Epshom
3	Carte des sédiments superficiels de la baie de Douamenez - partie nord	1/15 000	Augris et al./1988	M: Ifremer
4	Carte des sédiments superficiels de la baie de Douamenez	-	Augris et al./2004	M: Ifremer
5	Baie d'Audierne - 7147G	1/50 000	Gabeloteau/1996	M: Epshom
6	Carte sédimentologique sous-marine de Pont-Croix	1/100 000	Saint-Réquier/1969	M: CNEXO
7	De la pointe de Penmarc'h à la pointe de Trévignon - 7146G	1/50 000	Lefaou/1996	M: Epshom
8	De l'île de Penfret au plateau des Birvideaux - 7031G	1/50 000	Ehrhold et al./1994	M: Epshom
9	De l'île de Groix à Belle-île - 7032G	1/50 000	Dupont-Nivet/1998	M: Epshom
10	De Quiberon au Croisic - 7033G	1/50 000	Enet/1999	M: Epshom
11	Carte des formations superficielles sous-marines aux abords de l'île de Groix	1/20 000	Augris et al./1996	M: Ifremer
12	Carte sédimentologique sous-marine de Lorient à Quiberon	1/100 000	Pinot et Vanney/1972	M: CNEXO
13	Carte sédimentologique sous-marine de St-Nazaire	1/100 000	Vanney/1968	M: CNEXO
14	Carte sédimentologique sous-marine de l'île d'Yeu	1/100 000	Vanney/1971	M: CNEXO
15	Atlas des fonds meubles du plateau continental du Golfe de Gascogne	1/100 000	Chassé et Glemarec/1976	Atlas UBO/CNEXO
16	De la pointe du Grouin du Cou à la pointe de Chassiron - 7404G	1/50 000	Garnaud/1998	M: Epshom
17	De La Rochelle à la pointe de la Coubre - 7405G	1/50 000	Weber et al/2004	M: Epshom
18	Embouchure de la Gironde - 7026G	1/50 000	Mallet/1998	M: Epshom
19	Bassin d'Arcachon : carte de l'environnement marin	1/25 000	Bouchet/1995	M: Ifremer
20	carte des formations superficielles sous-marines devant la côte basque	1/20 000	Augris et al./1999	M: Ifremer

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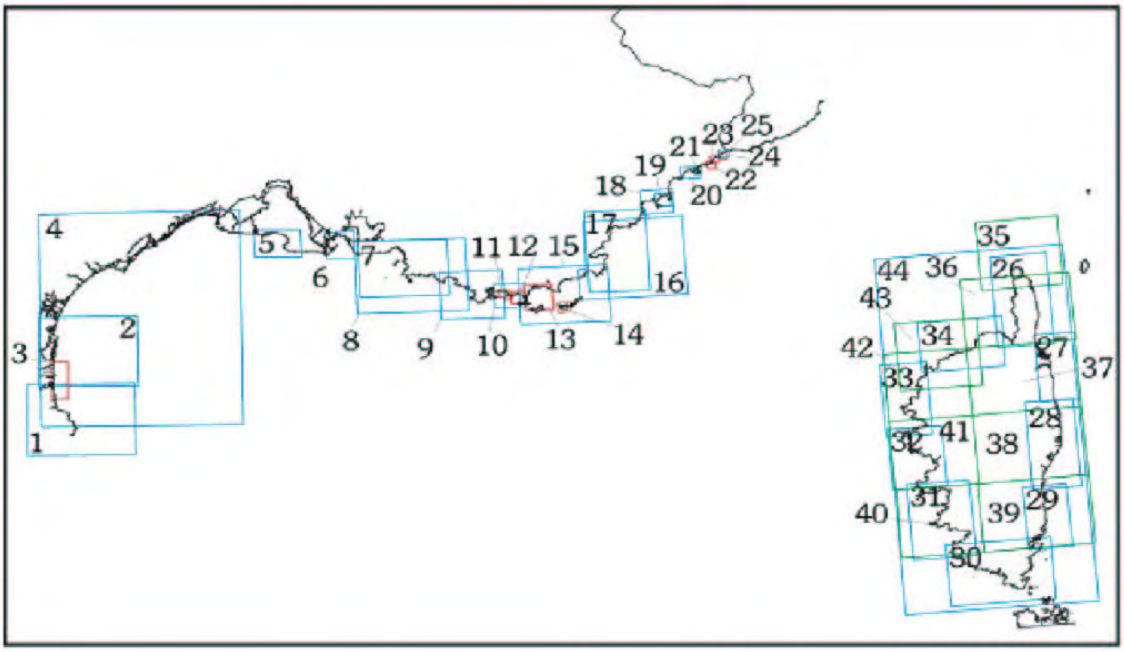
Annex 5

A. EHRHOLD, Ifremer

Figure 3: sedimentologic and bedform dynamic mapping
Limits of sedimentologic maps on Mediterranean coast



N°	Title	Scale	Authors/Date	Editor/source M: Map R : report
1	Carte sédimentologique sous-marine d'Argeles-sur-Mer	1/100 000	Duboul-Razavet et al./1970	M: BRGM/CNEXO
2	Carte sédimentologique sous-marine de Perpignan	1/100 000	Duboul-Razavet et al./1970	M: BRGM/CNEXO
3	Carte des formations superficielles entre Port Barcares et St-Cyprien	1/20 000	Augris et Mear/1993	M: Ifremer
4	Synthèse travaux Aloisi	-	-	-
5	Nature des fonds meubles sous-marins au sud de la camargue	-	Roux et Vernier	R: Cnexo
6	Carte des sédiments superficiels du golfe de Fos	-	Roux/1983	R
7	Nature des dépôts marins du cap Couronne au bec d'Aigle (in CSCF)	-	Blanc	R
8	Nature des dépôts meubles superficiels de la baie de marseille	1/100 000	Blanc et al./1972	M: CNEXO
9	Nature des dépôts marins du bec d'Aigle au cap Cepet (in CSCF)	-	Muschotti et blanc	R
10	Nature des dépôts marins du cap Cepet au golfe de Giens (in CSCF)	-	Blanc et al.	R
11	Carte de l'herbier de Posidonie et des fonds marins environnants - Toulon	1/10 000	Paillard et al./1993	M: Ifremer
12	Carte de l'herbier de Posidonie et des fonds marins environnants - Giens	1/10 000	Paillard et al./1994	M: Ifremer
13	Carte de l'herbier de Posidonie et des fonds marins environnants - Hyères	1/50 000	Paillard et al./1995	M: Ifremer
14	Carte des formations superciels du parc national de Port Cros	1/7500	Belsher et Houlagte/2001	M: Ifremer
15	Nature des dépôts marins de la presquîle de Giens au cap Camarat (in CSCF)	-	Blanc et al.	R
16	Nature des dépôts meubles superficiels de la baie de St-Tropez	1/50 000	Bellaiche/1974	M: CNEXO
17	Nature des dépôts marins du cap Camarat au cap Roux (in CSCF)	-	Blanc et al.	R
18	Nature des dépots marins des golfes Juan et de la Napoule	-	Nesteroff/1965	R (thesis)
19	Nature des fonds du golfe Juan	-	Bourgeois et al./1975	R (thesis)
20	Nature des sédiments des baies de Nice et de Villefranche-sur-Mer	-	Rapin/1980	R (thesis)
21	Nature des dépots marins de la rade de Villefranche	-	Baglinière/1978	R (thesis)
22 to 24	Cartes des sédiments superficiels marins de Menton au cap d'Ail	1/7500	Belsher et Houlgatte/2000	M: Ifremer
25	Fonds de la baie de Menton	-	Kremer/1975	R
26 to 34	Cartes des principaux peuplements et types de fonds (Corse)	-	Pasqualini/1997	R (thesis)
35 to 43	Cartes de nature du fond (CORSE)	1/100 000	LIMA project	M: BRGM
44	Carte sédimentaire du plateau corse (complitation des données au plomb suiffé)	-	Pluquet et al./2001	R

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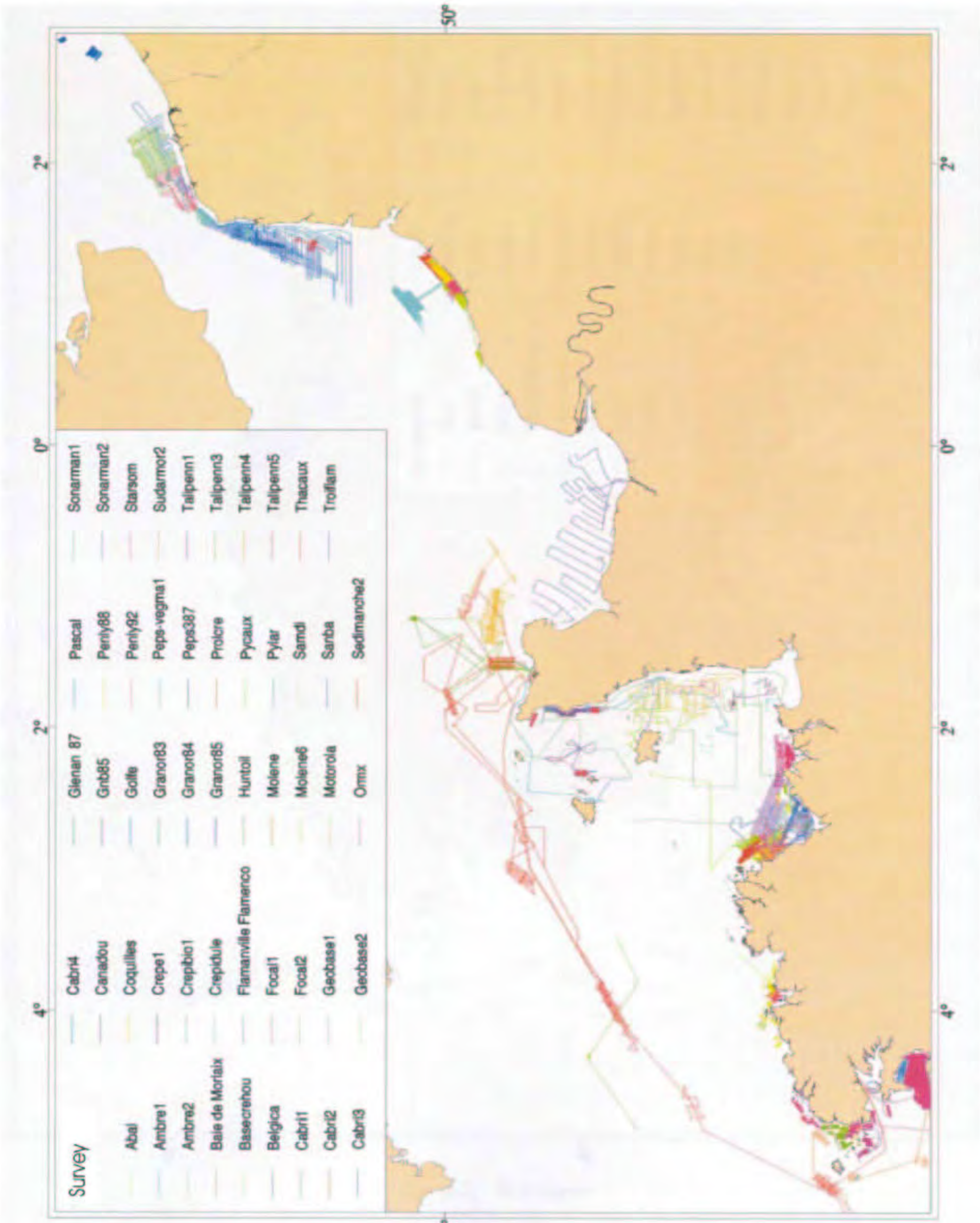
Annex 6



* Stephan M., Satra C., Augris C., Bourillet J.F., 2002 Synthèses géologiques sur le plateau continental français métropolitain. Recensement des campagnes côtières et documents produits, Ifremer/DRO-GM report, 49p

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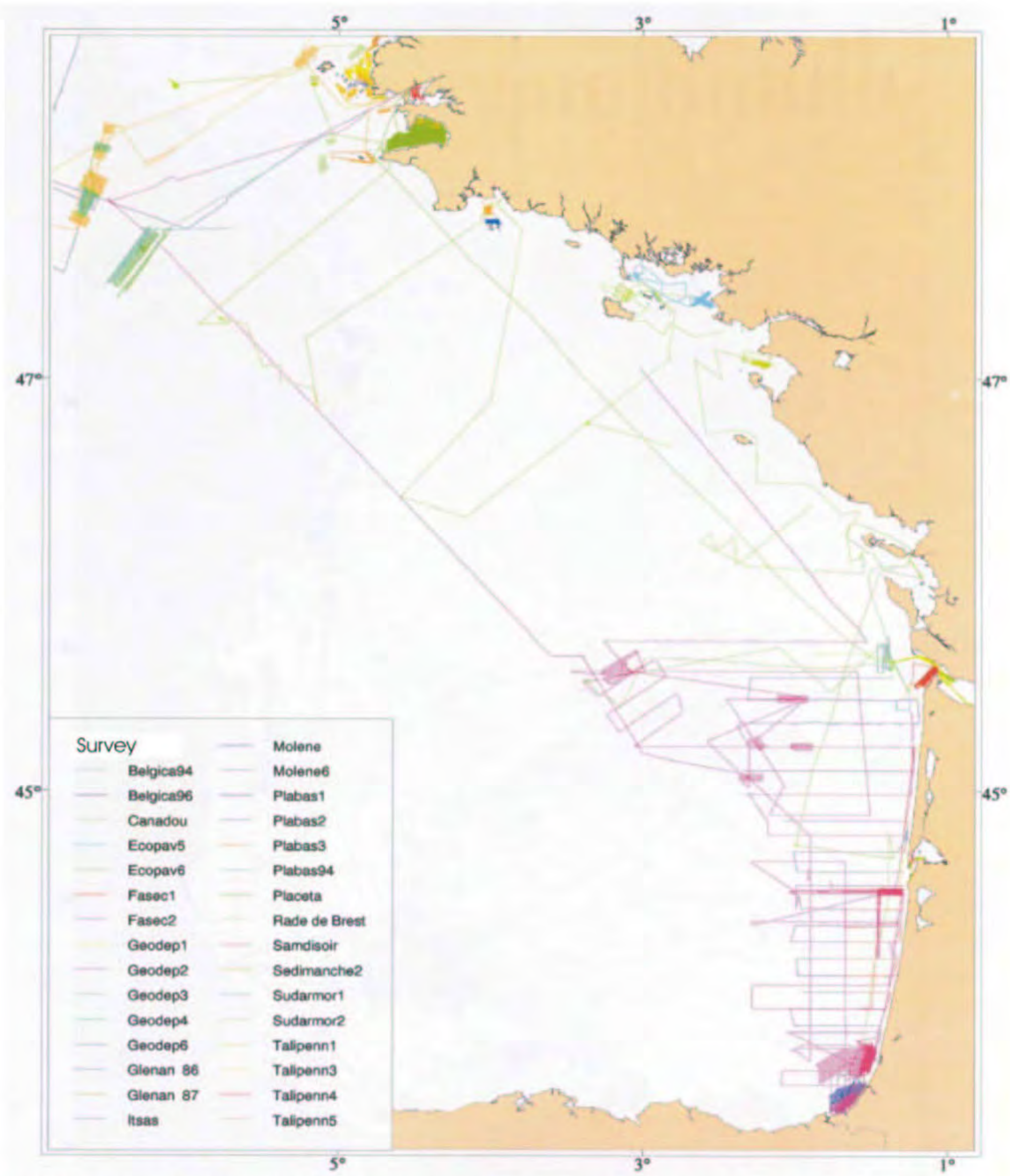
Annex 6

Figure 2: sedimentologic and bedform dynamic mapping
Location of acoustic profiles in Atlantic region*



* Stephan M., Satra C., Augris C., Bourillet J.F., 2002 Synthèses géologiques sur le plateau continental français métropolitain. Recensement des campagnes côtières et documents produits, Ifremer/DRO-GM report, 49p

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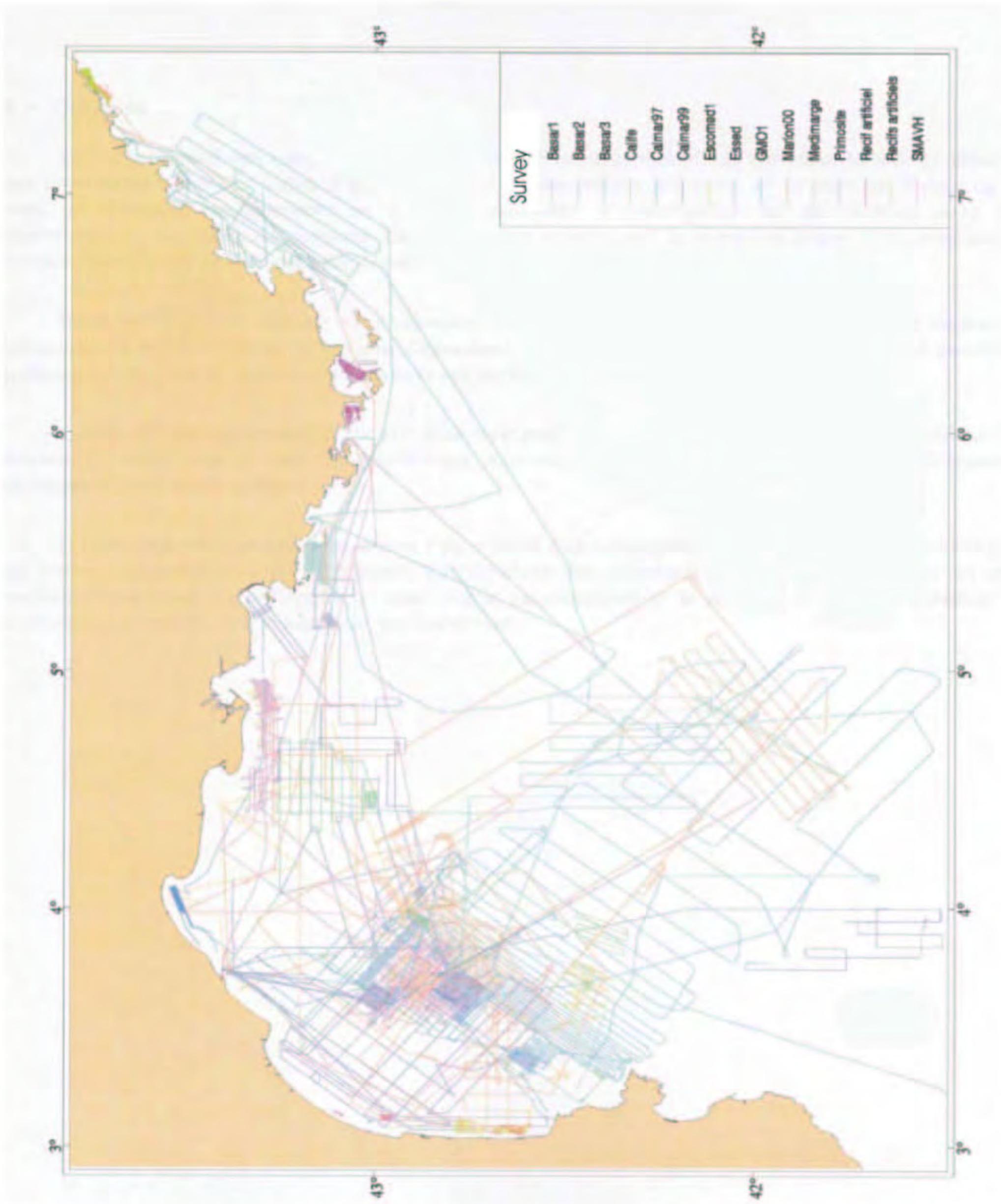

* Stephan M., Satra C., Augris C., Bourillet J.F., 2002 Synthèses géologiques sur le plateau continental français métropolitain. Recensement des campagnes côtières et documents produits, Ifremer/DRO-GM report, 49p

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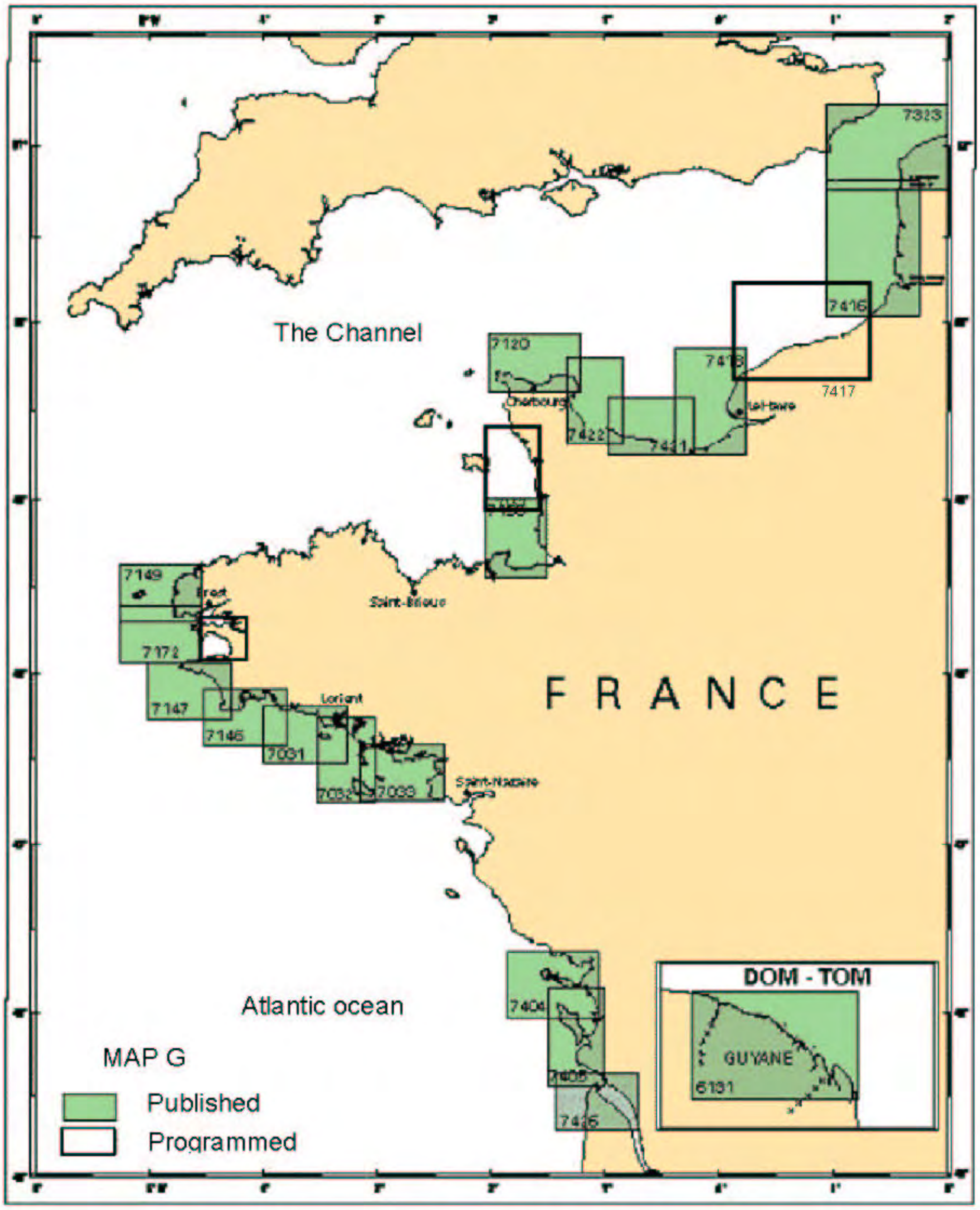
Annex 7

Figure 1: sedimentologic and bedform dynamic mapping
Map G project, SHOM (France)

http://www.shom.fr/fr_page/fr_act_geo/siteg_f.htm



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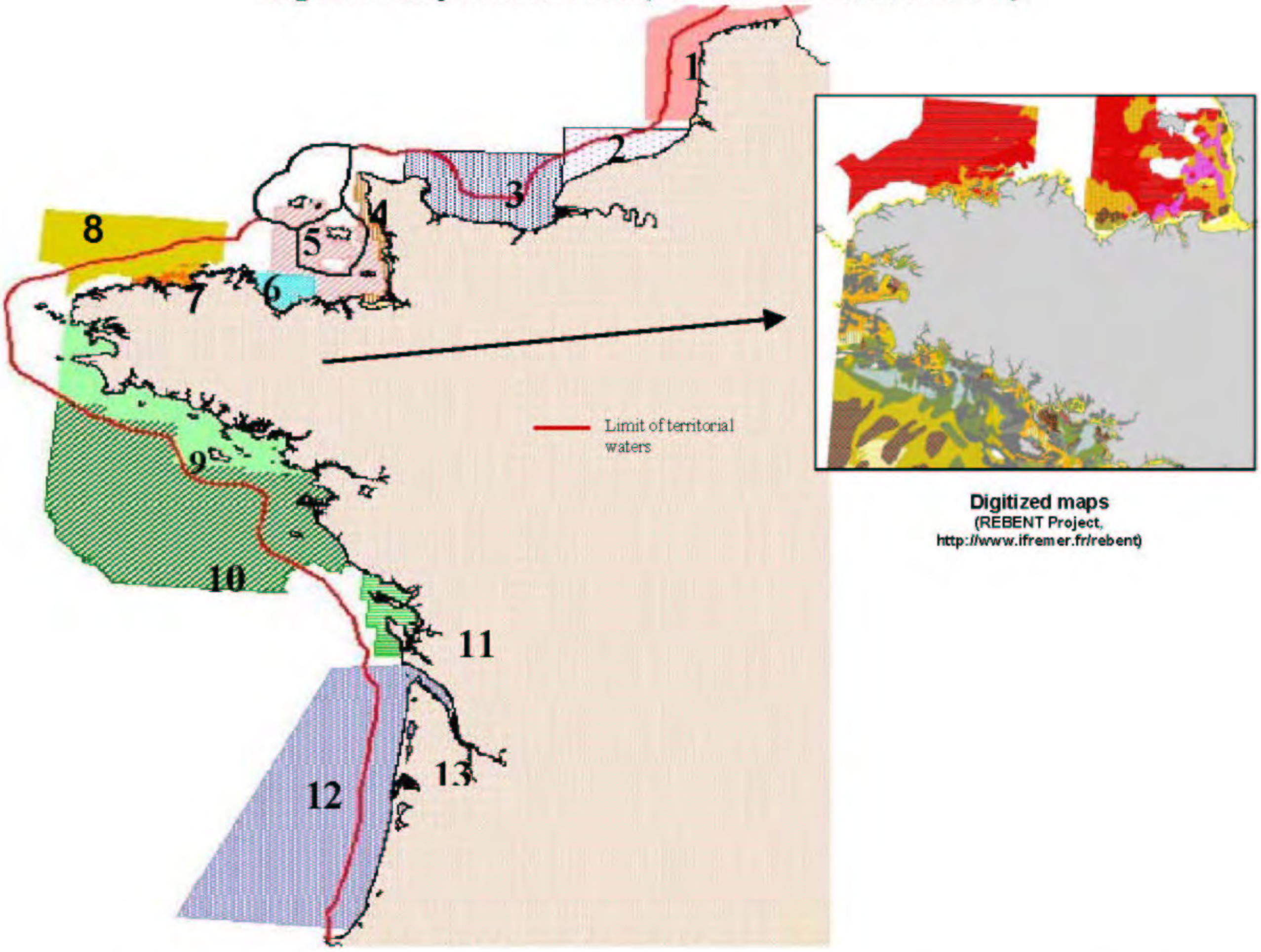
Annex 8

Figure 1: map of biocenosis (Channel and Atlantic coast)



N°	Authors	Date	Scale	Output
1	In Dauvin J.C., Dewarumez J.M., acording to Cabioch L. and Glaçon R. Davoult *et al.* San Vicente Vaslet *et al.* sediment map	2000 1975 1988 1995 1978	Scale unknown	Unpublished map
2	Cabioch L., Glaçon R.	1977	1/317 000	Publication
3	Gentil F., Cabioch L.	1997	1/117 000	Map published by "Station Biologique de Roscoff"
4	Guillaumont B., *et al.*	1987	1/25 000	Maps, Digitized map REBENT (2004)
5	Retière C.	1979	1/152 000	Thesis, Digitized map REBENT (2004)
6	Hamon D., Coic D.	1996	1/100 000	Atlas, Digitized map IFREMER (2004)
7	Cabioch L.	1968	1/180 000	Thesis, Digitized map REBENT (2004)
8	Cabioch L.	1968	1/50 000	Thesis, Digitized map REBENT (2004)
9	Chassé C., Glémarec M.	1976	1/100 000	Atlas, Digitized map REBENT (2004)
10	Chassé C., Glémarec M.	1976	1/500 000	Atlas, Digitized map REBENT (2004)
11	Hily C.	1978	1/75 000	Thesis, Digitized map to be qualified REBENT
12	Bouchet J.M.	1979	1/250 000	Maps, Digitized map to be qualified
13	Bouchet J.M.	1987	1/25 000	Map

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Figure 2: map of zostera beds (REBENT project)

Figure 3: map of maerl beds (REBENT project)

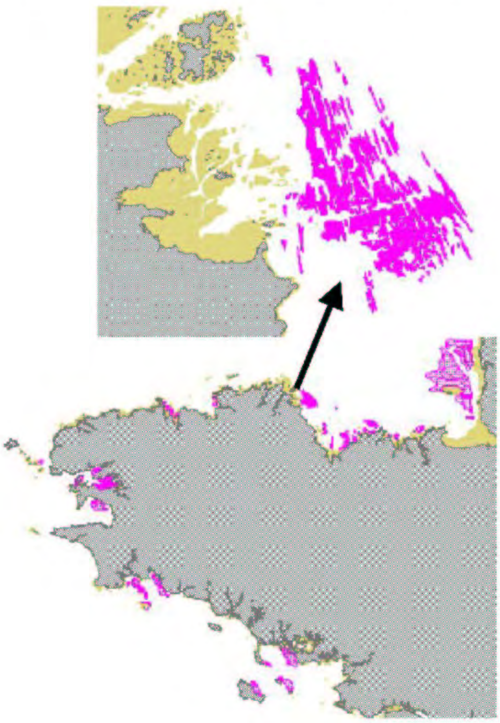

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Figure 4: Brittany: REBENT project, tidal areas or very shallow bottom

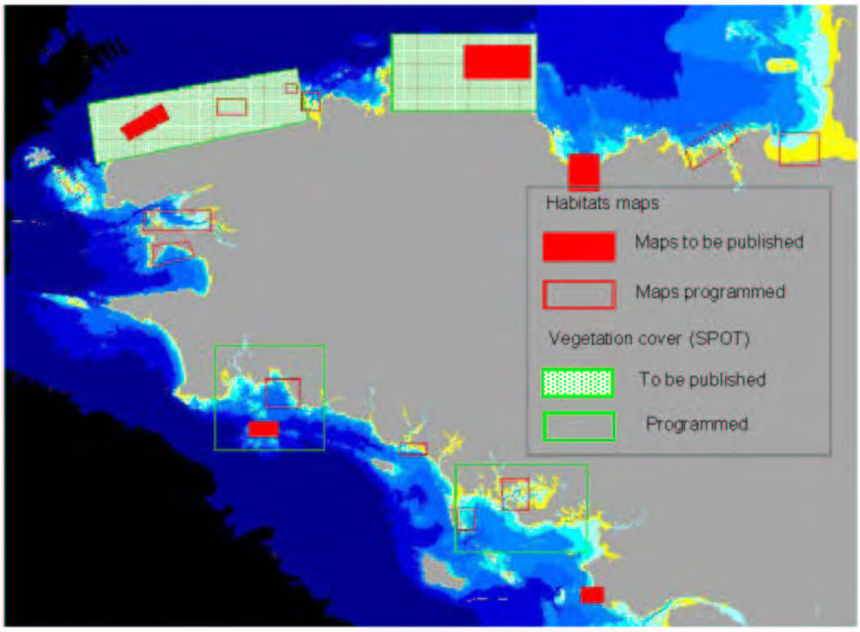

Figure 5, Brittany: REBENT project, subtidal areas

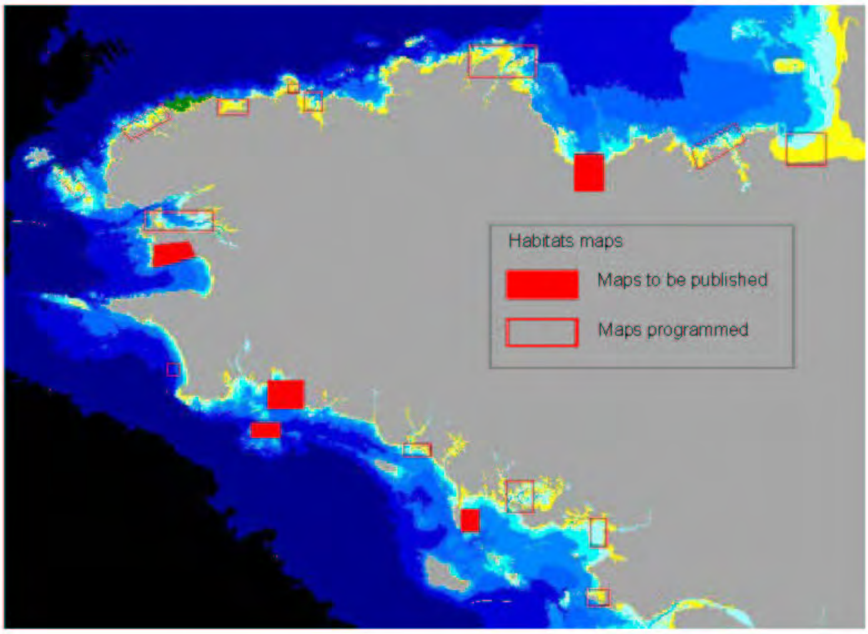

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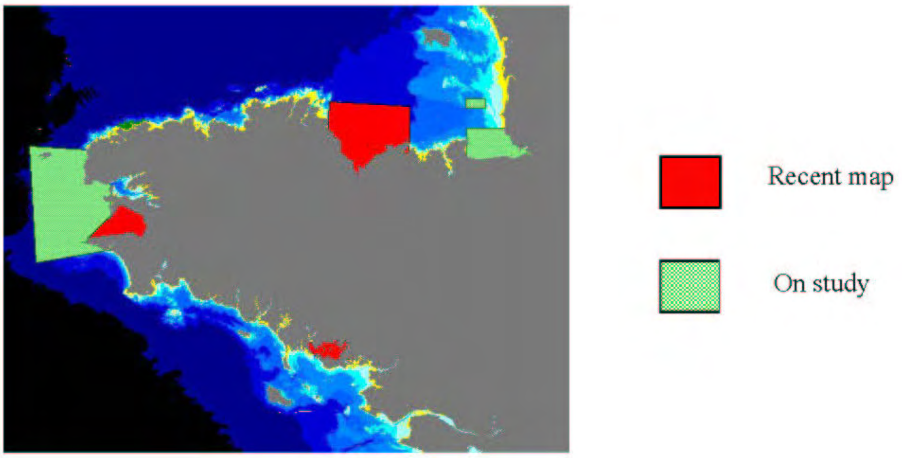
Figure 6: Brittany: recent map and map to be produced



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Annex 8 National status report for Ireland

Seabed mapping within Ireland during 2003

Fiona Fitzpatrick, MI, Ireland & Anthony Grehan, NUIG, Ireland

In 2003, four mapping initiatives were carried out within Irish waters, namely: continuation of the Irish National Seabed Survey, the mapping of groundfish stock assessment trawl sites, mapping of scallop beds and and deep-water ROV video and multibeam mapping of carbonate mounds and deep water corals in the Porcupine Seabight and western Porcupine Bank continental slope region in Irish waters. Additionally, an Irish inshore mapping strategy was completed and key areas targeted for future integrated mapping initiatives.

1. Irish National Seabed Survey

The Geological Survey of Ireland in conjunction with the Marine Institute manages the National Seabed Survey. A Steering Committee comprised of the Department of Communications, Marine and Natural Resources (DCMNR), the Department of Finance, the Geological Survey of Ireland (GSI) and the Marine Institute (MI), has overall responsibility for the direction and delivery of the project. A Technical Advisory Group meets quarterly to provide on-going advice on aspects of the work programme.

The key objective of the Seabed Survey is the acquisition, management and delivery of data in order to support the development of products and services, which will promote the sustainable management, and development of Irish marine resources. To achieve this successfully there was recognition by Government, at the inception of the project, of the need for a strong emphasis to be placed on the building of capacity in surveying, data management and interpretation over the duration of the project. The inherent objective being to ensure that Irish public agencies and the private sector would have the appropriate skills and expertise to maximise the State’s investment in the acquisition of the basic seafloor mapping dataset by going on to utilise the data in both commercial and management applications.

Seafloor under Irish jurisdiction is divided into three bathymetric zones (Zone 3 deeper than 200m which is already complete) with current effort concentrated in Zone 2, between the 50 and 200m isobaths and key areas of Zone 1, between the shore and the 50m isobath. Zone 2 operations, offshore Northern Donegal, were carried out between the 10th May and the 17th September 2003, employing the R.V. *Celtic Explorer* as the survey platform. Zone 1 mapping was carried out from the R.V. *Celtic Voyager,* between the 5th November and 3rd December and the survey area concentrated in the Greater Dublin Bay area.

Commissioned in 2003, the R.V. *Celtic Explorer* is fitted with a comprehensive suite of survey equipment including an EM1002 multibeam system and EA600 multi frequency single beam echo sounder. Both the EA600 and EM1002 receive DGPS positions information from the Fugro HP-Starfix and roll and heave computations from a Seapath 200 motion sensor, which also acts as the Common Reference Point (CRP) for the vessel payload. Three separate profilers provide the speed of sound in seawater correction for the acoustic sensors. Simultaneous profiles of the shallow sub sea floor geology are acquired using a 3.5kHz pinger system, comprising a Probe 5000S SBS topside unit interfaced to 4 hull-mounted Massa TR1075D transceivers. The Probe 5000S is triggered and recorded via a Coda Octopus system. The processed and raw output is recorded on both an Ultra paper recorder and to DAT tape. Interpretation is carried out onboard the vessel, again utilising Coda Octopus systems.

Whilst underway, continuous measurements of the Earths gravity field are recorded on a LaCoste and Romberg SL Gravity meter. The meter is calibrated during port calls with a portable gravity meter at a marked point on the Killybegs Quay. A Geometrics G881 Magnetometer towfish is also towed aft of the vessel. The returns, which are accurate to 0.01nT/Hz-RMS, are logged directly to MagLog software. Currently, all signal processing and interpretation, with the exception of gravity and magnetic signals, is carried out onboard the vessel.

The R.V. *Celtic Explorer* commenced survey work within the extreme northern section of Zone 2 of the Irish seafloor territories on the 11th May 2003. The plan for 2003, as defined by the GSI was to survey systematically from the extreme northwest section of Zone 2, eastward to the Ireland / UK border, and progressively southward towards Mallin Head. It was agreed that both survey line direction and areas of work were to be modified as appropriate by prevailing weather conditions. Survey operations progressed well and the survey campaign was divided into five 28-day legs with refuelling and crew change carried out in the Port of Killybegs, Donegal. Survey work ended on the 17th September 2003. The total ground coverage included an area of over 9,717km^2.

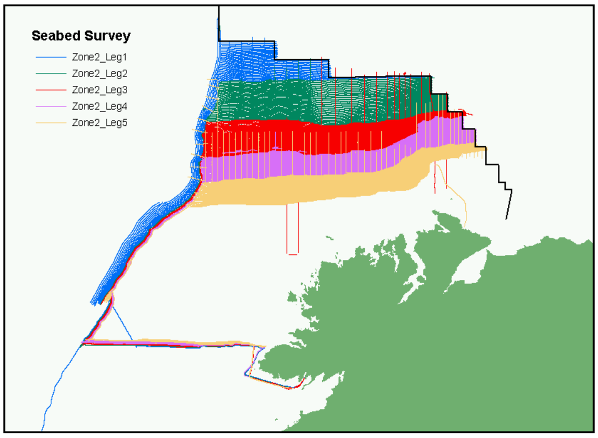


Figure 1. Diagram showing the survey tracklines and coverage from the 2003 Zone 2 survey.

The Dublin Bay survey was carried out between the 5th November and 3rd December 2003 with data gathered from the 34m R.V. *Celtic Voyager*. Mobilisation of the required payload was completed prior to the commencement of operations on the 5th November, whilst berthed alongside in Dublin Port. Operationally, the survey was carried out during daylight hours only, with the vessel returning to port by *c*. 18h00 daily. In total, 201km^2 of survey data were recorded over the period of the survey. The EM1002S multibeam system forms the primary data set, augmented with dual frequency single beam echo sounder, 3.5kHz pinger and magnetometer data. Fugro SPOT DGPS signals were employed as the primary positioning system, with Simrad Seapath providing secondary backup. Fugro SEIS was employed as the online navigation package and all data were collected to the specifications set for the INSS.

The area, designated Greater Dublin Bay, was delimited to the east by the 6°W meridian, and the southern and northern limits were set at the 53°N and 53°30'N parallels, respectively. Primary survey lines were set to trend in a due north-south-north directions with orthogonal crosslines surveyed into the ports of Dublin and Dun Laoghaire.

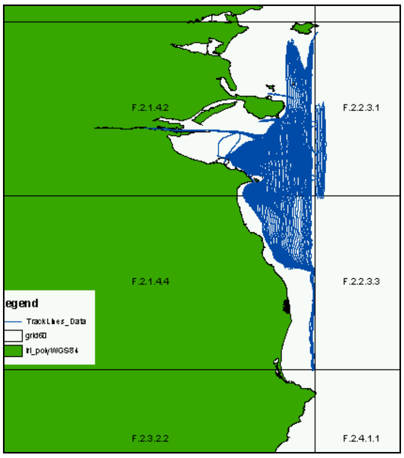


Figure 2. Diagram showing the survey tracklines from the 2003 Dublin Bay survey.

2. Groundfish stock assessment

The Irish Groundfish assessment survey constitutes three two-week surveys contributing to the annual survey program carried out by EU and International Commission for the Exploration of the Sea (ICES) member states. The main purpose of the survey is to provide abundance indices of juvenile commercially important target species, through benthic trawling of previous and newly acquired sites and the categorising, weighing and ageing of the catch. The results of which, when coupled together with other results from adjacent and previous surveys, are compiled to create an indication of the state and sustainability of these target species and the fisheries they inhabit. The target species concerned are haddock, whiting, megrim, plaice, cod, hake, monkfish, sole, john dory, mackerel, herring, scad and sprat.

The method of sampling is to categorise, weigh and age each catch, or a sub sample if the catch is sufficiently large. Each catch is initially categorised by species and then sexed, then samples of the target species, categorised into cm length groups, are weighed. A representational sub sample is then aged by analysis of the otoliths. Any detritus or seaweed is also recorded for each catch. The results are then compiled to give an index of the relative abundance of juveniles.

The location of sites available for trawling, has to date been constrained to known safe trawl sites, thus minimising possible damage to the net though submerged obstructions, rocky sea floor and any loose detritus and boulders present on the sea floor – any object capable of snagging and tearing the net is deemed to be sufficient reason not to trawl in that location. Additionally, records of commercial tow areas are available, but these tows are known to be in excess of 20km along meandering tracks. With only discrete point locations known for these sites they are deemed unsafe at which to deploy nets. Critical to the success and the economic viability of the study is to have sufficient trawl locations available each day - five or six ideally and all within close proximity.

As the fisheries operations are limited to daylight hours only, multibeam and echo sounder data were collected during the night; identifying safe new trawl sites and checking commercial trawl locations for obstructions. In addition to providing the groundfish scientists with information on the type of the seafloor, enabling an informed decision on the type of net to be deployed, the data gathered can be fed directly into the national data base.

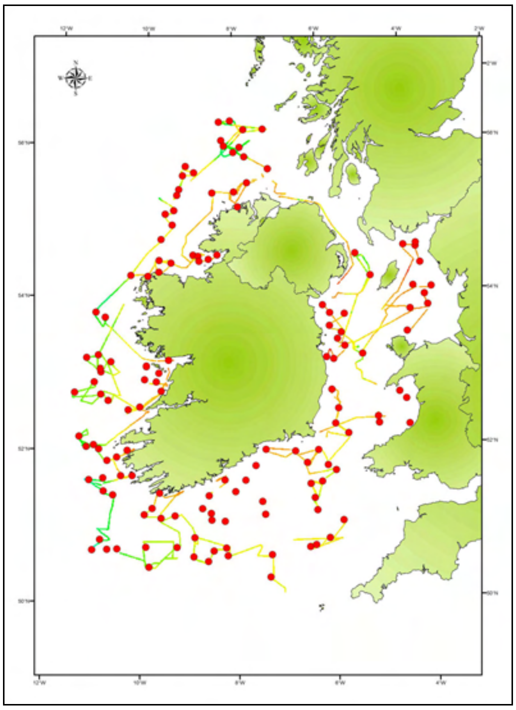


Figure 3. Potential trawl sites identified by multibeam surveys during the Groundfish stock assessment trials.

3. Stock assessment of scallops on the South Coast of Ireland 2001–2004

The Coastal and Marine Resources Centre (CMRC), in conjunction with the Irish Sea Fisheries Board, Trinity College Dublin, the Marine Institute and the Geological Survey of Ireland are carrying out a multibeam sonar mapping and scallop stock assessment employing GIS data integration in support of sustainable fisheries management. The research is being undertaken as a principal component in a multidisciplinary approach to the development of a strategic plan for the management of scallop stocks (*Pecten maximus*) off the south east coast of Ireland. A series of GIS tools are used in conjunction with a geodatabase in order to assist in evaluating the relationship between seabed sediment type and scallop stock density. Geophysical data layers including multibeam sonar maps (MBES bathymetry, morphology and acoustic backscatter) and other seabed data layers (sediment samples, sub-sea video imagery, statistical sediment classifications) are overlain and analysed in combination with layers of quantitative biological data showing scallop catch rates.

Initial results indicate that high scallop catch rates are strongly correlated with one of two predominant and acoustically distinct sediment types that occur extensively within existing scallop grounds. Seabed imagery acquired during ongoing field surveys with georeferenced underwater towed video cameras is being integrated within the GIS database in order to further analyse, ground truth and refine inferred sediment classes and their spatial configuration. Catch rate results from stock assessment survey transects positioned on the basis of sediment backscatter imagery have demonstrated the potential for applying integrated digital mapping techniques in order to predict and operationally target areas with a high potential scallop yield. Scope thus realised for improving catch efficiency (CPUE) can be used in concert with closed area and other conservation measures to scientifically underpin future sustainable management policy initiatives for this economically important fishery.

The south east coastal shelf is the location for Ireland's most important national King Scallop (*Pecten maximus*) fishery. A detailed scientific understanding of the mechanisms governing abundance and distribution of both adult and larval scallop are important in order to ultimately identify and delineate management zones within the fishery, e.g., for protection of spawning stock. Existing knowledge of scallop ecology indicates that population distributions are patchy, and that high scallop abundance correlates with coarser sediments such as sands and gravels. Multibeam sonar systems have become the tools of choice in the mapping of seabed topography, morphology and sediment characteristics. When used in conjunction with optical imagery (still and video recordings) and sediment samples the composite picture thus generated facilitates very detailed spatial characterisation of seabed substrates and habitats.

MBES sonar data were collected using the RV *Celtic Voyager,* equipped with a Simrad EM1002S. Coherent overlapping (20-30%) swathes of sonar coverage were generated within discrete blocks whose size and location were prioritised in order to coincide with areas of high scallop density as determined from the results of the initial stock assessments. Samples of surficial seabed sediments were collected during the surveys using a Shipek grab and initially described on the basis of their physical appearance (e.g., clean fine sand with many small shell fragments). Subsequent granulometric analyses were conducted using laboratory standard sieves and laser particle size analysis for finer fractions. All MBES data were managed and post-processed using CARIS™ HIPS (Hydrographic Information Processing System, CARIS, 2003).

GIS is an essential element of study, and ArcView (V3.3) has been used to provide a common platform in which all spatial data are integrated and where analytical operations are undertaken. Tasks range from initial operational planning for survey coverage through to data integration, analysis, presentation and map production. All data are projected from WGS 84 geographic co-ordinates to a common reference frame in UTM. Tabulated point data (sediment samples, photographic locations, scallop sample tow locations) are imported via SQL, whilst MBES data products are imported directly.

The initial broad-scale stock density surveys detected commercial sized scallop at densities of up to 300 individuals per tow. Densities in excess of 80 were encountered over a large semi-continuous area extending seaward to the 80m isobath directly south of the major estuary of the River Suir. The distribution of scallop within the study area is shown in Figure 4. Coherent MBES data covering approximately 65% of the total area of the south coast scallop grounds was generated during two annual field (2001/2) campaigns.

During the final stages of the project statistical classification techniques will be applied to the whole dataset in order to refine the largely qualitative analyses and correlations so far outlined. This will lead to the production of sediment/biotope maps in which the most potentially productive scallop areas are delineated. These maps will thus provide the spatial basis to underpin future stock management plans. It is also anticipated that the methodologies developed during this work can be validated and geographically extended enabling the identification of new areas with high scallop fishery potential.

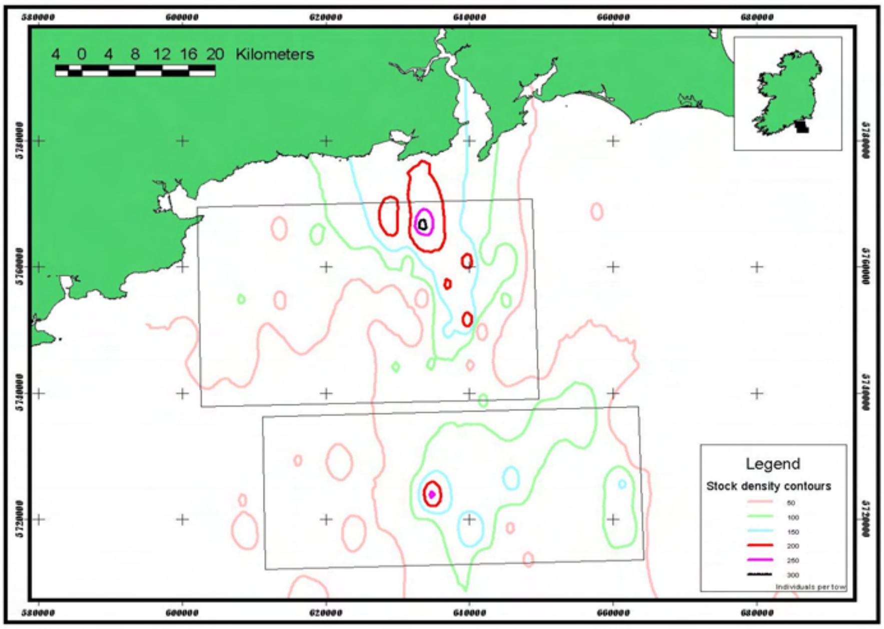


Figure 4. Map showing the location and general arrangement of the south east coast scallop grounds. Colour coded contours indicate the broad distribution of scallop within the areas under study.

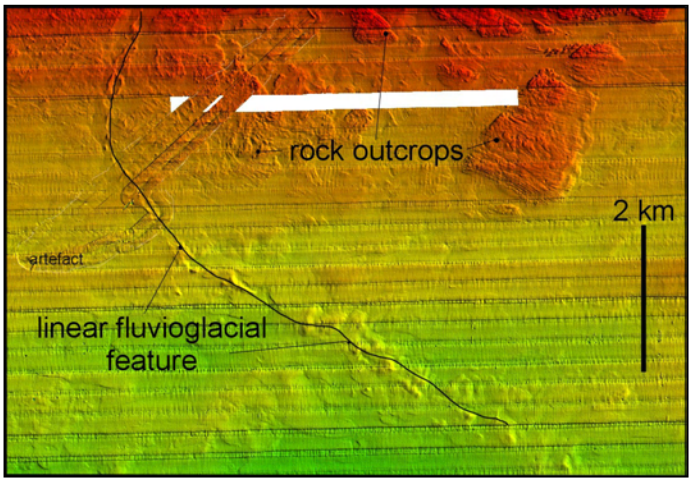


Figure 5. Sun illuminated shaded relief image generated from raw multibeam sonar bathymetric data. Obvious artefacts (horizontal along track stripes, shape outlined in black) will be normally be removed during subsequent post processing.

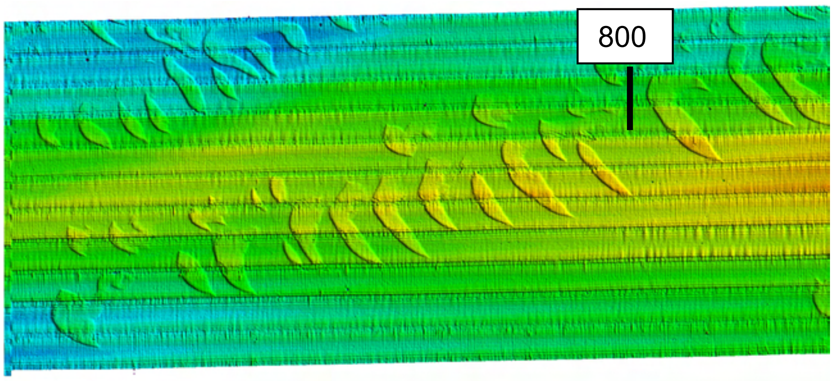


Figure 6. Sun illuminated shaded relief image generated from raw multibeam sonar bathymetric data. The linear arrangement of dune structures is clearly visible.

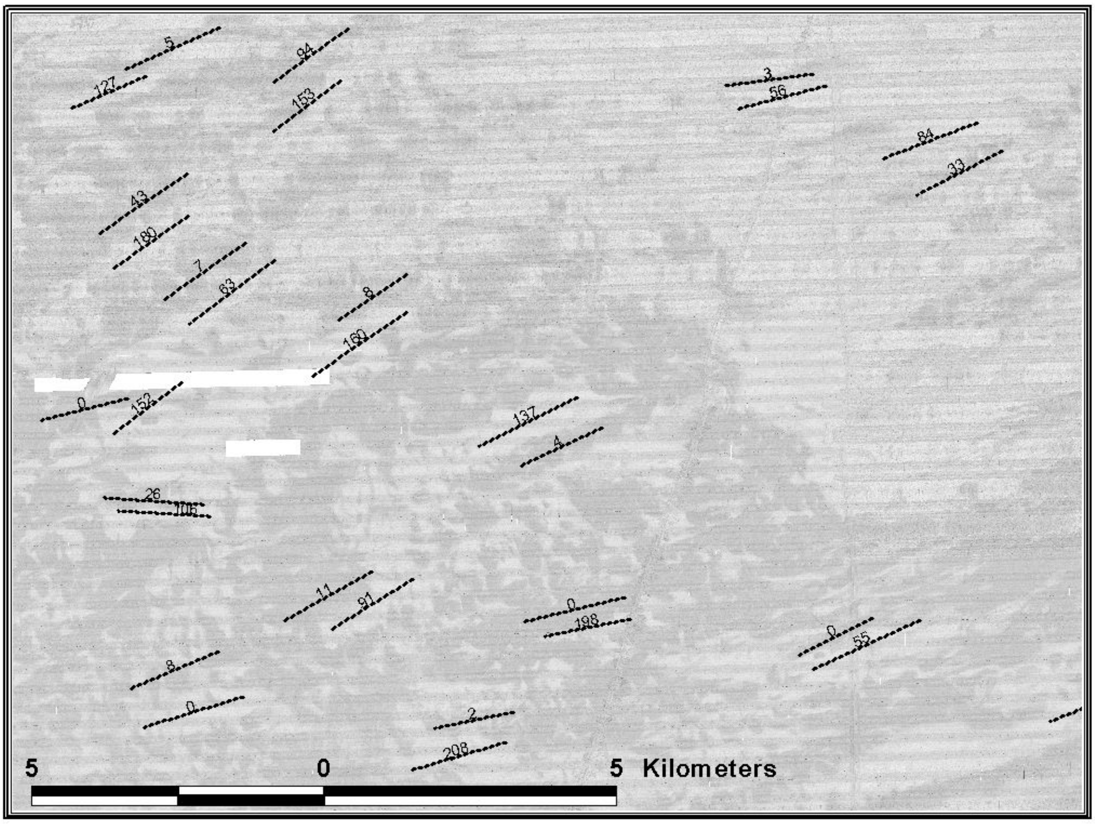


Figure 7. Multibeam backscatter image showing the sharp contrast in acoustic signature derived from the sandier dune structures (dark) and surrounding coarser gravely sediments (light). Scallop catch data are overlain showing numbers per tow along side each track line. Coloured spots indicate start and end points of each sample tow.

4. Polarstern ARK XIX/3a

A joint Alfred Wegener Institut (AWI) and Institut Francais de Recherche pour l'exploitation de la mer (IFREMER) international research cruise was undertaken aboard the German ice-breaker RV Polarstern from June 2nd to June 20th, 2003. Detailed mapping of a number of carbonate mounds and deep water coral targets found between 600 to 1000 m off the west coast was undertaken using the IFREMER 'VICTOR 6000' research remotely operated vehicle (ROV).

Researchers from several European countries including Germany, the United Kingdom, Belgium, France and Ireland also participated. More than 100 hours of video were recorded during 9 dives, which covered over 100km of seafloor in the Porcupine Seabight and on the western slope of the Porcupine Bank. When combined with previous work carried out during an earlier IFREMER organized cruise (CARACOLE) with VICTOR in 2001, these surveys will enable the production of the most detailed deep-water habitat maps available to date.

In addition to high-resolution video and digital stills, a number of sites were surveyed with ROV mounted multibeam producing detailed microbathymetry maps capable of resolving features at a deci-meter scale. Between dive time was utilized to take box-core and CTD samples and to deploy long-term instrumented landers. As well as increasing understanding of carbonate mound genesis and deep water coral ecosystem function, the cruise will provide important scientific data underpinning the designation of deep water coral Special Areas of Conservation (SAC) under the EU Habitats Directive. Damage to coral habitats by trawling was evident at a number of mound locations.

5. Inshore mapping strategy

The Marine Institute is presently finalising a strategy document for inshore integrated surveys in Ireland. The strategy has identified key areas and methods of survey. The bays and estuaries along the Irish coast targeted as loci for sea floor mapping have been identified in consultation with the various users and stakeholders. The identified bays and estuaries were then examined individually and their relative importance assessed in terms of their relevance to shipping routes, fisheries, Natura 2000 status, archaeological status, etc. The bays were grouped and graded and the final selection returned to stakeholders for peer review. Priority-mapping requirements have been spilt into priority bays and priority areas. Prioritising bays and areas of strategic importance were compiled with respect to multi-user requirements (which involved an assessment of stakeholders requirements).

The following criteria were considered for selecting priority areas:

- Presence of fishing / goods port, proximity to heavy shipping traffic routes and possible west coast ports of refuge
- Areas of importance for Built / Natural Heritage
- Presence of Aquaculture in the bays
- Important fishing areas containing spawning grounds, nursery areas and juvenile fish grounds. Also includes whether the area is within the new Irish Conservation Box that extends into the coastline. Important shellfish sites are also considered
- Water bodies requiring monitoring under the WFD (as result of being eutrophic / potentially eutrophic)

Other important criteria include:

- Established / proposed / possible future wind farm sites
- Areas that have potential for wave / tidal energy
- Presence of aggregates such as sand & gravel resources and important maërl deposits
- Mineral and ore deposits
- Proximity to dredge & dump sites

In summary, twenty-three priority bays have been identified as the primary loci for an inshore survey, with three coastal regions and the coastal extension of the new Irish Conservation Box. Three bays have been identified as primary targets. These areas and environs have been targeted following a review of legal, commercial, recreational and site-specific environmental demands. During the consultation process, it has become clear that any mapping survey within the inshore zone has to satisfy a variety of requirements and the data must accommodate multidisciplinary needs and integrated interrogation. To this end, the appropriate technology has been identified and a generic mapping approach designed; dividing Zone 1 into two bathymetric zones bounded by the 0 to 10m and 10 to 50m isobaths. Although, in practice, each survey area will be considered individually, multibeam echo sounding has been adopted as the defining tool; dictating line spacing and therefore ultimate cost.

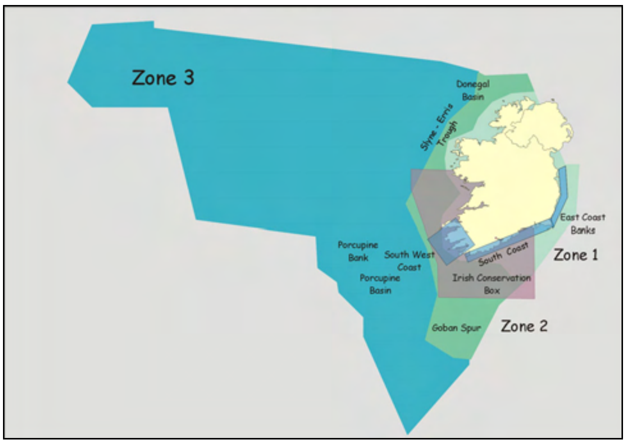


Figure 8. Areas identified as priority deeper water sites – the New Irish Conservation Box (purple).

Figure 9. The South West Coast, South Coast and East Coast Banks Areas of priority, with the three major bays of importance – the Shannon Estuary, Dingle Bay and Waterford Harbour indicated.

Annex 9 National Status Report for Norway

John Alvsvåg, Institute of Marine Research

Habitat mapping projects in Norway 2003

As for the 2002 report the response from Norwegian research institutions where low, and only 7 projects where added to the table. In four of this projects Institute of Marine Research are involved, and the Norwegian Institute of Water Research are responsible for the rest of the projects.

Mareco

MAR-ECO is an international research project in which scientists from 16 nations take part. Norway, represented by the Institute of Marine Research and the University of Bergen, co-ordinates the project which will enhance our understanding of occurrence, distribution and ecology of animals and animal communities along the Mid-Atlantic. In 2004, a two-month major international expedition is being planned for the new Norwegian vessel RV G.O. Sars, but vessels from Iceland, Russia, Germany, the United Kingdom and Portugal will also take part (Figure 1). MAR-ECO shall enhance the basic knowledge of ocean life and thereby contribute to a sustainable international management of marine resources and the priceless biodiversity of the marine environment.

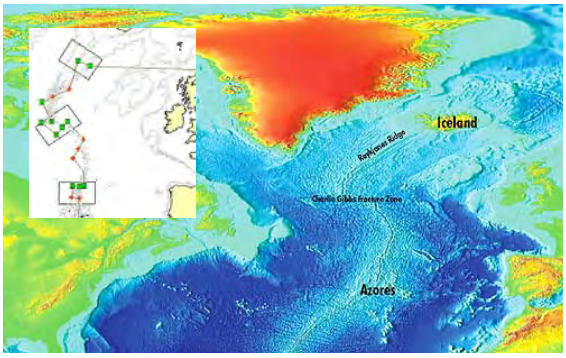


Figure 1. Sampling area for the Mareco project 2004.

The key issues for the project is to

- Mapping of species composition and distribution patterns
- Identification of tropic interrelationships and modelling of food-web patterns
- Analyses of life history strategies

The project will collect videos, pictures from the seabed and multibeam maps from areas along the Mid-Atlantic witch together with the collection of biological data can be used to produce habitat maps from the areas.

The project can be followed at the website http://www.mar-eco.no/ during the remainder of the project period toward the conclusion in 2008.

Coral mapping

In addition to more data collection from the "Røst reef" mapped in 2002 (figure 2a), the mapping of deep water coral areas where also carry through in 2003. In the "Træna" area (Figure 2b), more than 1400 possible coral reefs where detected within a 13 x 22km area, from geo-morphology structures from multibeam maps. For further information visit the website http://www.imr.no/coral/.

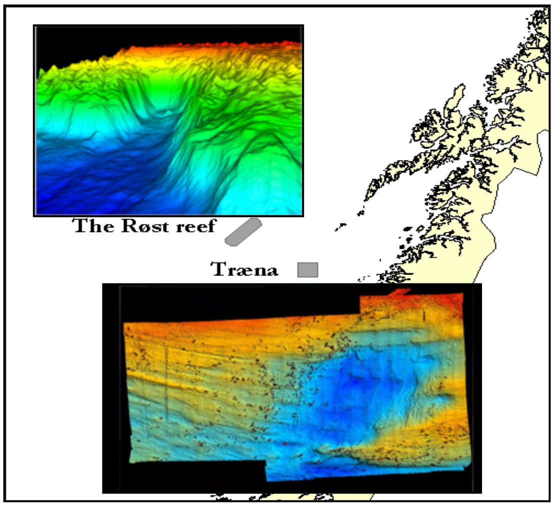


Figure 2. Additional mapping of the "Røst reef"(A) and the “Træna” area (B).

Mafcons

(Managing Fisheries to Conserve Groundfish and Benthic Invertebrates Species Diversity)

EC founded project to test if local production is affected by fishing activities by the use of Huston´s Dynamic Equilibrium Model. Data is collected at the 3rd quarter international groundfish surveys (IBTS). Epifauna is colected with a 2m beamtrawl, and infauna is collected with vanVeen grab. In addition the grain size is analysed. Data will be reported to the EC in 2006.

Costal monitoring

In Norway the Directorate of Nature Management has defined 11 costal landscape areas and 4 key habitats for specific species, for local governmental mapping of biodiversity. 12 pilot areas where elected to test the Directorate of Nature Managements’ guidelines for mapping of marine biodiversity.

Annex 10 The Integrated Ocean Mapping Program of the USA

Integrated Ocean Mapping Program – Actionable Plan

A NOAA-wide Effort to Map and Characterize the Seabed of the U.S. Exclusive Economic Zone

Purpose: Of the 11.9 million square kilometers of seafloor within the U.S. EEZ, only 10% has been mapped. This leaves 10.7 million square kilometers, an area larger than the United States, virtually unmapped and unexplored. As a Nation, we know next to nothing about the topography, habitats, or resources of this vast area that is under our jurisdiction. If we are to increase our knowledge of the ecosystems of the EEZ, an integrated approach to comprehensively map and characterize the seabed should be undertaken. Mapping the physical, biological, geological, chemical, and archaeological elements of the U.S. EEZ will lay the foundation for refined research and will improve ecosystem management efforts.

Some Recent Reports Citing the Need for Ocean Mapping

- Report of the President's Panel on Ocean Exploration
- The Pew Oceans Commission Report

The NOAA Ocean Exploration and Research Matrix program proposes an Integrated Ocean Mapping (IOM) program activity to systematically map and characterize important areas and ecosystems of the U.S. EEZ. This effort recognizes and embraces current surveying and mapping efforts that fulfill individual NOAA Line and Program Office responsibilities, and will provide a nexus for establishing mapping priorities and combining resources to conduct large-scale and site-specific surveys. These efforts will enable NOAA to quickly identify and characterize areas of biological, geological, chemical, and archaeological importance, as well as to understand more about the nature and effect of human activities conducted in these areas.

The IOM program activity meets two of the four overarching goals of NOAA's mission:

1) Protect, restore, and manage the use of coastal and ocean resources through ecosystem management approaches
2) Support the Nation's commerce with information for safe and efficient transportation

This effort also requires and will build on NOAA's surveying, mapping, and research expertise. Furthermore, this initiative will expand partnerships with other federal and state institutions that conduct ocean mapping (U.S. Geological Survey, Department of Defense), as well as academic and private institutions.

The Vision: The goal of the IOM program activity is to improve progress on surveying and mapping the world's oceans, with initial emphasis on the U.S. EEZ and other areas that are suspected to support unique living and non-living resources. The effort seeks to accomplish this through: (1) establishing a cross Line office team that can develop a comprehensive strategy to guide NOAA surveying and mapping efforts; (2) establishing standards for collecting data and characterizing habitat at an agreed upon level that help meet multiple program needs; and (3) investing in the infrastructure - vessels, instruments, personnel, data management - to get the job done.

Some NOAA programs involved in Surveying & Mapping

- NOS Office of Coast Survey
- NOS National Marine Sanctuaries Program
- NOS Centers for Coastal Ocean Science
- OAR Office of Ocean Exploration
- OAR National Undersea Research Program
- NMFS Fisheries Science Centers (6)

It is the intention of the IOM effort to establish a framework for identifying priority areas to be surveyed, to determine at what scale and to what standard these areas should be surveyed, and to plan and execute the surveys and maximize results. Such a framework will provide for surveying large areas of unknown ocean very quickly at a low resolution in order to identify areas of interest, as well as surveying smaller areas at a much higher resolution to prepare detailed products required by scientists and natural resource managers. This includes collecting data on the presence and distribution of living and non-living resources, archaeological artifacts, and physical phenomena such as water chemistry.

This program provides for ensuring NOAA vessels are outfitted appropriately for conducting multiple sensor surveys (i.e., multibeam, side scan sonar, sub-bottom profiling), and for ensuring the appropriate and efficient use of commercial survey vessels that are equally outfitted. Furthermore, the IOM effort will help guide the acquisition and use of human occupied submersibles, remotely operated vehicles (ROV), and autonomous underwater vehicles (AUV) for exploring and characterizing areas of interest. Finally, by establishing a cross Line office team and developing a strategic approach to mapping, this program provides a foundation for ensuring NOAA stays abreast of changes in technology that could enhance surveying and mapping operations.

The success of the IOM program is predicated on establishing a framework and process for NOAA Program Offices that are involved in ocean mapping to iteratively assess ongoing efforts, establish meaningful protocols and procedures, and to implement existing mapping projects in a new context, as well as identify new efforts requiring new funds. Through the IOM effort, NOAA programs will be better integrated in executing mapping activities. Thus, single mapping efforts will be better positioned to meet the objectives of multiple NOAA programs.

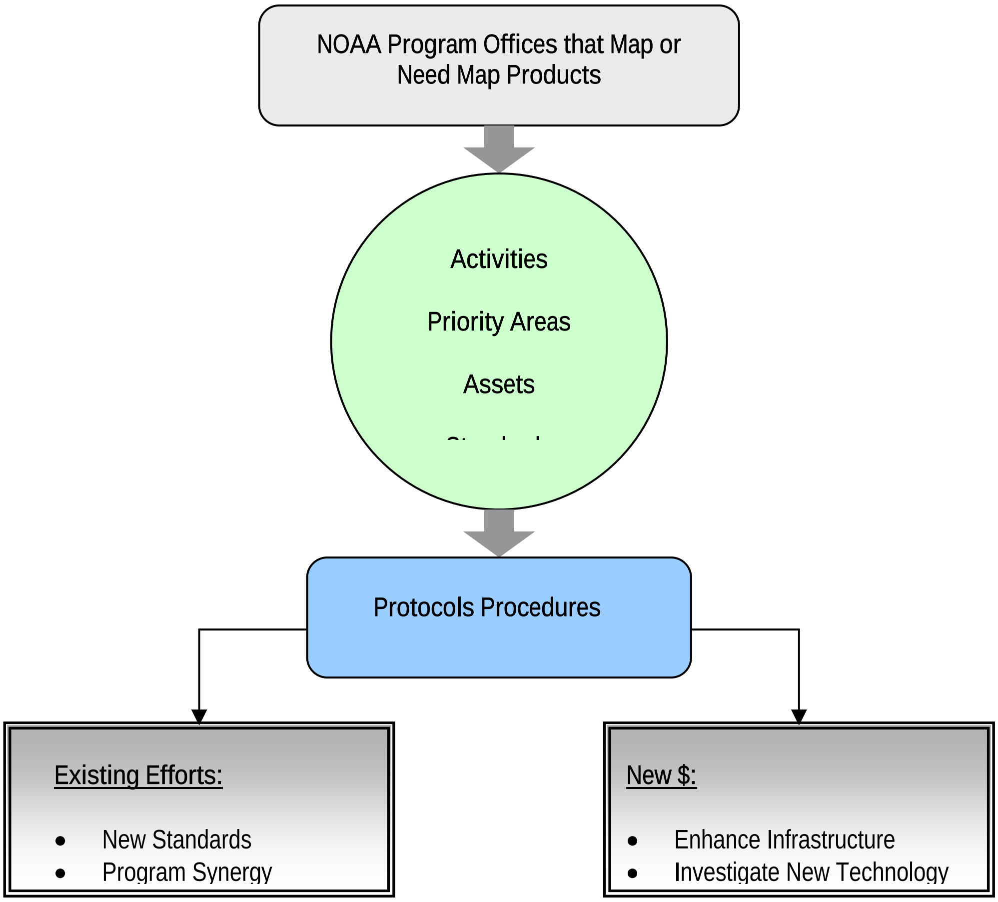


Figure 1. Overview of Integrated Ocean Mapping effort. IOM provides for better management of existing efforts, and effective application of new funds as they become available.

An Approach: Given that approximately 10.7 million square kilometers of the U.S. EEZ remain to be surveyed and mapped, and given that the Nation and NOAA have critical needs to conduct these operations in other areas of the world, it is critical that we establish a strategic, integrated approach to our surveying and mapping efforts. The following outlines a phased approach that: (1) builds on current and planned mapping activities; (2) assesses potential overlaps, gaps, and needs; (3) develops common procedures and protocols where it makes sense; and (4) provides a foundation for evaluating results and planning new activities over time. Note: the process is not linear – the phases overlap through time.

TIME	PRIMARY PHASES	INPUTS	TEAM
Dec '03 thru Jan '04	**PHASE I – The Current Situation:** • Who is currently engaged in mapping efforts? • Where are these efforts focused? • How are these efforts being conducted? • Are there critical partners? • What standards apply? • What are the results? • Where is the data and is it accessible?	• Existing Plans • PBA • Surveys	CORE GROUP
Jan '04 thru Mar '04	**PHASE II – Existing Plans:** • Who is planning efforts? • Where and when? • How will these be conducted? • Are there critical partners? • What standards will apply? • What are the planned results? • How will the data be handled? • Will existing $ be used? • Are new $ required?	• Existing Plans • PBA • Surveys	CORE GROUP
Feb '04 thru Apr '04	**PHASE III – Assessment:** • Are there overlaps? • Are there gaps? • Assets acquired? • Assets required? • Are there common standards? • Data management methods – pros and cons? • Compatibility of products?	• Phase I & II output • PBA • Work Session(s) – 1 for assessment – 1 for standards	ADVISORY GROUP
Apr '04	**PHASE IV – Summary Document of Above**	• Phase I – III output	CORE GROUP
Feb '04 thru Jul '04	**PHASE V – Develop an Operations Plan:** • Documenting and describing existing coverages • Setting priorities and schedules • Developing and applying standards • Designing a database and access points (GIS) • Developing data linkages • Designing data products and displays • Assessing and linking new technologies	• Summary document	CORE GROUP
Jan '04 thru Sep '04	**PHASE VI – Develop IOM efforts for FY '05-'06:** • Identify existing efforts and "New Starts" • Identify "low hanging fruit" for FY '05-'06 • Cost assessment and funding sources • Select "New Starts" and activities • Implementation • Evaluation (Criteria) • Outyear planning	• Operations Plan • Input from Phases I – III • Work Session(s)	ADVISORY GROUP DECISON MAKERS
Oct '04 thru Sep '05	PHASE VII – Implementation • Implement "New Starts" and activities • Evaluation (Criteria) • Outyear planning	Operations Plan	ALL TEAMS

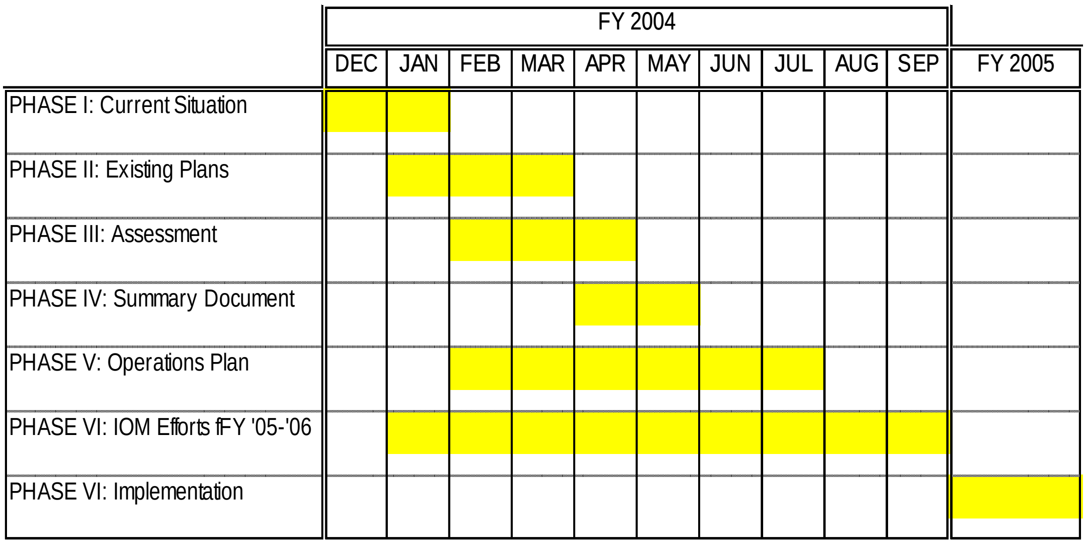


Figure 2. Proposed schedule for implementing IOM phases.

Organizing for Success: Effective implementation of the phases described above requires the formation of at least three distinct teams tasked with specific duties and responsibilities. These include a "Core Group" of representatives from each Program Office that is involved in mapping, and "Advisory Group" comprised of Program Office Directors and project managers, and a group of "Decision Makers" comprised of Line Office AAs and Deputies, Program Office Directors, and project managers. The members of the last group are flexible depending on the nature of the decision to be made. It is anticipated that these teams can actively engage in the tasks associated with the phases described above, and that they will maintain and build on existing established partnerships. The following outlines and describes these groups:

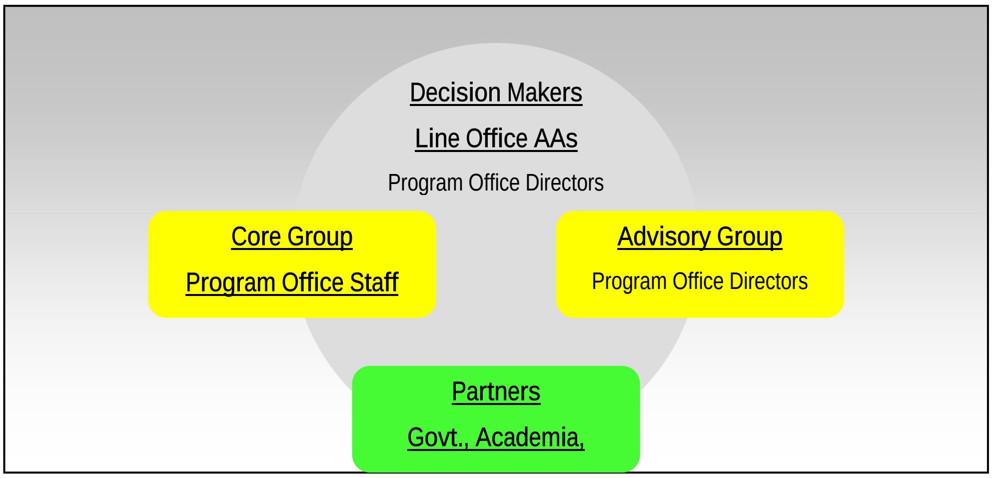


Figure x. Organizing for success – IOM team structure.

CORE GROUP

- Manage process
- Generate materials
- Develop products
- Organize "focus groups"
  - Assets & technology
  - Data management
  - Standards

ADVISORY GROUP

- Review materials & products
- Evaluate outcomes
- Modifications & edits
- Present to Decision Makers

DECISIONMAKERS

- Set priorities
- Secure assets
- Secure staff & resources
- Secure new $

Gauging Progress: The process described is one of continuous management, resulting in a framework for improving existing mapping activities, selecting new areas for investment, implementing new efforts, evaluating results, and making modifications. It is an iterative process whereby participants can use the knowledge gained over time to better use and target resources for mapping, as well as to generate results. As such, performance over time can be measured in both quantitative and qualitative terms. Although by no means complete, the following list some of the performance measures that can be achieved through an IOM program:

a. Qualitative performance measures:
- process in place for establishing surveying and mapping priorities over time
- improved inventory of existing mapping activities
- improved inventory of existing coverage (started by UNH)
- standards for specific mapping activities
- seabed classification scheme with applicable standards
- improved efficiencies in use of survey vessels

b. Quantitative performance measures:
- increase in number of square nautical miles surveyed
- increase in number of full-time survey vessels
- increase in number of survey days
- percent increase in amount of surveyed area that has been visually inspected (ground-truthed)
- percent increase in amount of surveyed area that has been characterized (habitat maps)

Next Steps: Given agreement on the process, the most critical next steps include identifying staff to participate on the teams (especially the "Core" working group), and to initiate Phase I. However, given current NOAA Matrix Management activities, and the need to establish some initial priorities for additional investments in ocean mapping in FY '05 and '06, next steps should also include identifying "low hanging fruit", i.e., new projects and/or efforts such as developing a data management scheme.

Conclusion: An Integrated Ocean Mapping program activity is critical to NOAA and the Nation. The U.S. EEZ is largely unexplored, unmapped and insufficiently characterized. A coordinated NOAA mapping effort can dramatically improve our progress towards understanding and wisely managing this vast area of the U.S. The IOM effort will include:

1) Strategic planning and coordination of existing efforts, which will begin as soon as practical and require minimal additional investment.
2) Broad level mapping of the U.S. EEZ and associated development of survey instruments, data centers and new technologies.
3) High-resolution mapping and characterization of high priority ecosystems.

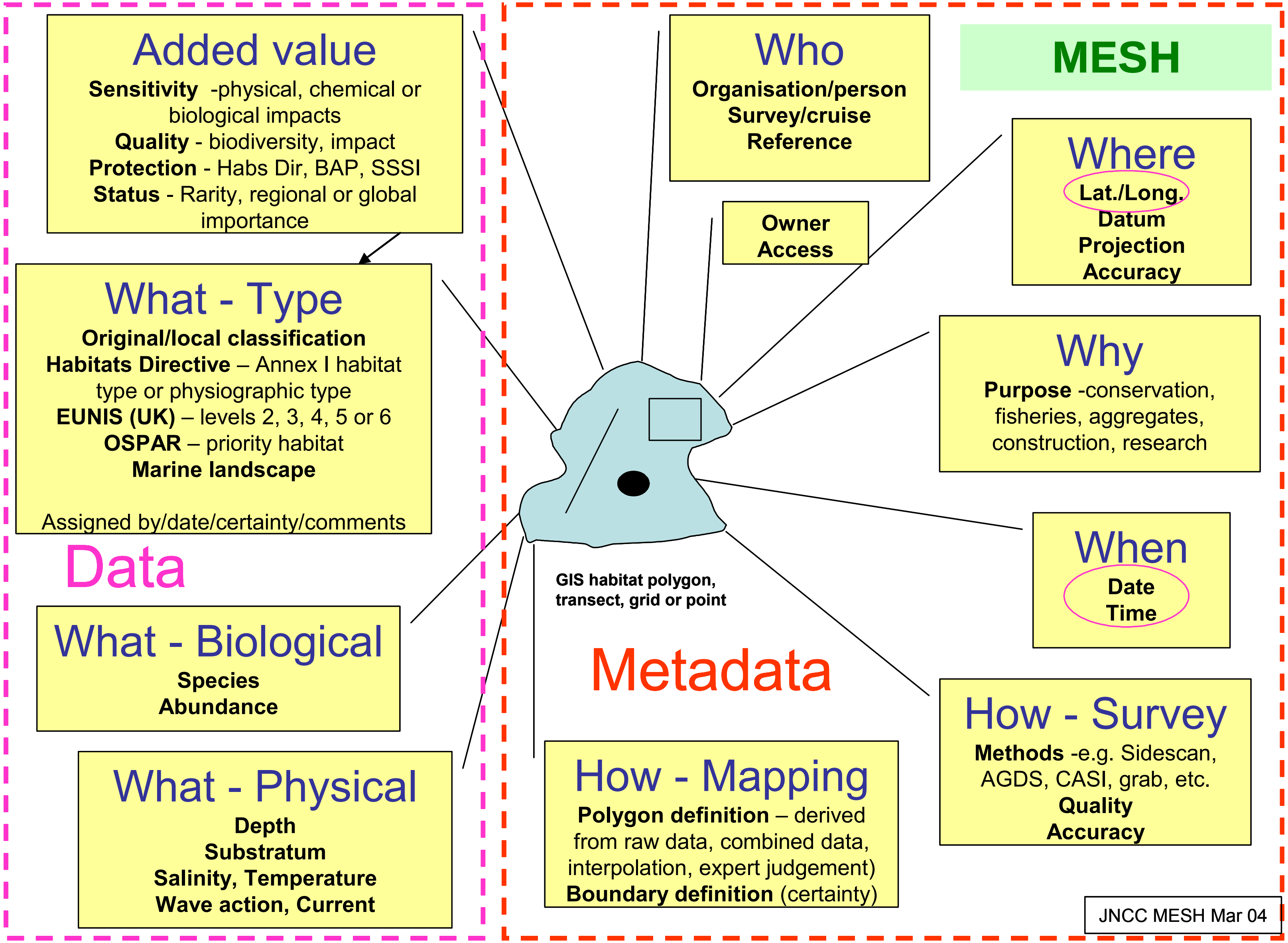
The benefits of this program will be far reaching and cannot be overestimated. It will also lead to a dramatic improvement in the rate of mapping the U.S. and its undersea territory. The NOAA Ocean Exploration and Research Matrix program is prepared to initiate the first stages of this program immediately, in conjunction with representatives from the NOAA Program Offices that are involved in mapping, as much of the organizational and planning effort can be conducted with available resources.

Appendix: *Cost and effort differences for mapping shallow vs. deep areas**

Depth Range	Σ Area (nm²)*	nm²/Ship/Year	Ship-Years	$/ nm²
0-60 m	460,000	2,250	205	$4,500
60-140 m	140,000	7,500	20	$1,300
140-600 m	140,000	32,000	4	$ 312
600-1000 m	90,000	120,000	2	$ 83
1000+ m	1,150,000	215,000	5	$ 46
HI and Pacific (deep)	1,500,000	215,000	7	$ 46
HI and Pacific (0-200)	6,000	7,500	2	$1,300
TOTAL	**3,486,000 nm²**		**245**	

*(*Based on Discussion Paper, "EEZ Surveys – Time and Cost Estimates," Office of Coast Survey, March 27, 2002.)*

Annex 11 Schematic model showing metadata and data that should ideally be available for habitat maps.



Annex 12 Draft list of metadata fileds for seabed mapping and ground-truthing techniques

Grab Sampling*	example entry
General Info.	
Time (eg GMT +/-)	
Date	
Sea conditions	
Name of vessel	
Water depth (metres)	
Depth datum used (eg Chart datum LAT)	
Grab method	Day grab
Replicate Reference	1 of 4
Replicate spatial reference	
Record validity	complete record (grab)
Device area (sq m)	0.1m2
Total area sampled	0.4m2
Penetration depth (cm)	20cm
Sieve mesh size (mm)	1mm
Volume (litres)	6 litres
Positional information	
Coordinate system	
Positioning system (eg dGPS)	
dGPS Beacon used & Accuracy	
Post-Processing	
Species data type	quantitative (nos per m2)
Sample storage medium (eg Formaldehyde)	
Sample storage reference number	
Photographic reference (if yes, add code)	
Particle Size Analysis sub-sample reference	
Format of accessible data (in MS Excel/MS Access)	

* subject to change pending ISO standard

Thanks to contributions from
David Connor
Annika Mitchell
Bob Foster-Smith
Jim Bennell
Louise Lieberknecht
Fiona Fitzpatrick

Annex 12 (Continued)

Benthic trawl/dredge	example entry
General Info. / System settings	
Time (eg GMT +/-)	
Date	
Sea conditions	
Name of vessel	
Water depth	
Depth datum used (eg Chart datum LAT)	
Method	Beam Trawl
Device size	2 metre
Length of tow	500 metres
Total area sampled	1000 square metres
Tow reference	tow 1
Record quality	incomplete record
Validity (was trawl/dredge successful)	Yes
Positional information	
Coordinate system	
Positioning system (eg dGPS)	
dGPS Beacon used & Accuracy	
Tow start coordinate (latitude)	
Tow start coordinate (longitude)	
Tow end coordinate (latitude)	
Tow end coordinate (longitude)	
U/W positioning system (USBL)	
Average orientation (eg 180°)	
Post-Processing	
Species data type	Presence
Sample storage medium (eg Formaldehyde)	
Sample storage reference number	
Photographic reference (if yes, add code)	
Format of accessible data (in MS Excel/MS Access)	

Remote/Diver video	example entry
General Info. / System settings	
Time (eg GMT +/-)	
Date	
Sea conditions	
Name of vessel	RV Aplysia
Water depth	
Depth datum used (eg Chart datum LAT)	
Method	towed video sledge
Sensor 1 name	Digital camera DCR-VX 1000, Sony
Sensor 2 name	Underwater lamps NR 2000, Nite-Rider Lighting Systems
Storage Medium	Digital video cassette, Mini DV
Validity (video quality)	Good
Positional information	
Coordinate system	WGS84
Positioning system (eg dGPS)	dGPS
dGPS Beacon used & Accuracy	Port Lynas
West bounding coordinate	
East bounding coordinate	
North bounding coordinate	
South bounding coordinate	
Tow start coordinate (latitude)	
Tow start coordinate (longitude)	
Tow end coordinate (latitude)	
Tow end coordinate (longitude)	
U/W positioning system (USBL)	U/W positioning system (USBL)
Average orientation (eg 180°)	Average orientation (eg 180°)
Post-Processing	
Storage medium reference	
Format of accessible data	

Annex 12 (Continued)

CASI	example entry
General Info.	
Time (eg GMT +/-)	
Date	
Sea conditions	
Orinetation of survey lines	
Flying height (m)	
Sunglint	
Wind direction	
% cloud cover	
Positional information	
Coordinate system	
Positioning system (eg dGPS)	
dGPS Beacon used & Accuracy	
Casi system	
Instrument type	
Vertical accuracy (m)	
Horizontal resolution	
Horizontal accuracy	
Wavebands used	
Storage media/format	
warp model used/georeferencing	
Land cover map output	
Classification method	
% accuracy of land cover map	
Continuous variable map	
r-squared value between predicted and actual variable	
RMSE error	
Model used to generate value	
Post-Processing	
Format of accessible data	
groundtruthing x ref to sample data	

Annex 12 (Continued)

Satellite/Aerial photography*	example entry
General Info. / System settings	
Time (eg GMT +/-)	
Date	
Source of data (eg US Government)	
Platform name	Landsat III
Flying height (m) (± 10 to 100 m)	3000
Instrument name	Multispectral scanner
Instrument type	imager
Collection type	whiskbroom
Film type	colour
view angle	
instantaneous field of view	
Number of bands	3
Positional information	
Centre longitude	
Centre latitude	
Coordinate system used	
Georeferencing bandwidths	
Image layers	
Band measurement mode ID's	
Thematic layer identification	Thematic
Image format	
Interleaving	BIP
Cell value type	unsigned integer
Bits per pixel	32
Post-Processing	
Format of accessible data	

* extracted from Geospatial Metadata
Standard for the Faculty of Environmental Studies, 2002

Annex 12 (Continued)

AGDS	example entry
General Info.	
Time (eg GMT +/-)	
Date	
Sea conditions	
Orientation of survey lines	
Name of vessel	RV Prince Madog
Water depth (metres)	
depth datum used (e.g. chart datum & LAT)	
System settings	
Type of system (RoxAnn, QTC)	RoxAnn
Echo-sounder	JVC 2000
Operating frequency	200 kHz
Transducer type: hull or side mounted	hull
depth of sounder below surface (metres)	1 metre
Beam width and shape (footprint)	
Sv (speed of sound used in echosounder)	
Operating power (range setting)	20 metres
Vessel speed	20m
Positional information	
Coordinate system	WGS84/lat long/OSGB?
Positioning system (eg dGPS)	
dGPS Beacon used & Accuracy	
dGPS offset from transducer mount (+/- ref to datum point)	3 metres
Survey bounds (upper left/bottom right)?	
Track point data	
Navigation file name	e.g.: ****.txt
Logging software used	Microplot/QTC View
Track point data fromat	Excel/ ASCII txt
Track spacing	200 metres
point save frequency (seconds)	
Time and date of each data point (for tidal correction)	Yes
Number of separate track files in dataset	6
Raw RoxaAnn files available	yes/with surveyor/no
QTC: FFV & CAL files available	yes/with surveyor/no
QTC: Q values available	yes/with surveyor/no
Files amalgamated	yes
Total size of dataset	24,500 records
Data processing	yes/no/partial
Depth correction	Yes
Nearest port used	Boston/Iona
Time interval	10mins
QA depth & position	yes
Number of data marked as dubious/removed	marked/500
E1E2 standardised	yes 95th %
Data interpolated: grids available	yes
Grid format	ASCII XYZ
Software used	Surfer/Spatial Analyst/Vertical Mapper
Grid spacing	300 metres
Interpolation algorithm	Inv distance/kriging
Details of model	Power 2/exponential
Search radius (distance over which interpolation is done)	300 metres
Type of search	Quadrant
Max points used	8/quadrant
Smoothing factor if used	not used/20 etc
Format of accessible data	

Annex 12 (Continued)

LIDAR	example entry
General Info.	
Time (eg GMT +/-)	
Date	
% cloud cover	
Sea conditions	
System settings	
Type of instrument	ADS40 Leica Geosystems LIDAR system
flight height (metres/feet)	7,000 feet
field of view (degree)	24
average post spacing (m)	2.84
Swathe width (m)	900
% overlap between adjacent swaths	30
Number of pulses per second	24,000
type of data collection	1+1 (1 return & 1 intensity value per pulse)
Name of airport used	Dallas
Horizontal resolution	
Vertical accuracy	
Coordinate system	
Post-Processing	
Format of accessible data	
Storage medium reference	
Groundtruthing x ref to sample data	

Annex 12 (Continued)

side-scan sonar	example entry
General Info.	
Time (eg GMT +/-)	
Date	
Sea conditions	
Name of vessel	RV Lough Foyle
Water depth (metres)	Water depth (metres)
Depth datum used (eg Chart datum LAT)	Depth datum used (eg Chart datum LAT)
Survey/Cruise name	
Positional information	
Coordinate system	
Positioning system (eg dGPS)	
dGPS Beacon used & Accuracy	
Spatial position at start of tow	
Spatial position at end of tow	
System settings	
Towfish/acquisition equipment	EdgeTech 270 TD towfish
Topside recording device	
Name of vessel	RV Lough Foyle
horizontal beam width	
vertical beam width	
beam depression angle	
Operating frequency (kHz) (or specify dual freq)	200
vessel tow speed (knots)	
Range setting (m)	50
Dynamic range of system	
Swathe width (twice range)(m)	100
Swathe (survey line) number	
Swathe (survey line) orientation	
Storage media (tape drive)	
Hard copy available (print-out)	
Post-Processing	
Has data been corrected for speed of vessel over ground (Y/N)	
dGPS offset from cable attachment (m)	
Use of positioning beacon on towfish (UBSL)	
Towfish layback (metres) (from datum point)	
Slant range corrected (y/n)	yes
has data been geo-referenced (Y/N)	
Storage format of data	Q'mips
gain correction (auto or can true backscatter amplitude be recovered)	auto
Navigation file name	
Format of accessible data	

Mult-beam sonar	example entry

awaiting information on ISO standard fields

Annex 13 Report of the subgroup on development of habitat maps for the North Sea

Members of the sub-group

Brian Todd, Dave Limpenny, Ibon Galparsoro, Kerstin Geitner, Els Verfaillie, Jorgen Leth, John Alvsvåg, Craig Brown, Neil Golding, Kjell Magnus Norderhaug, Chris Cogan, Dieter Boedeker.

Is this a good plan? Should we do it?

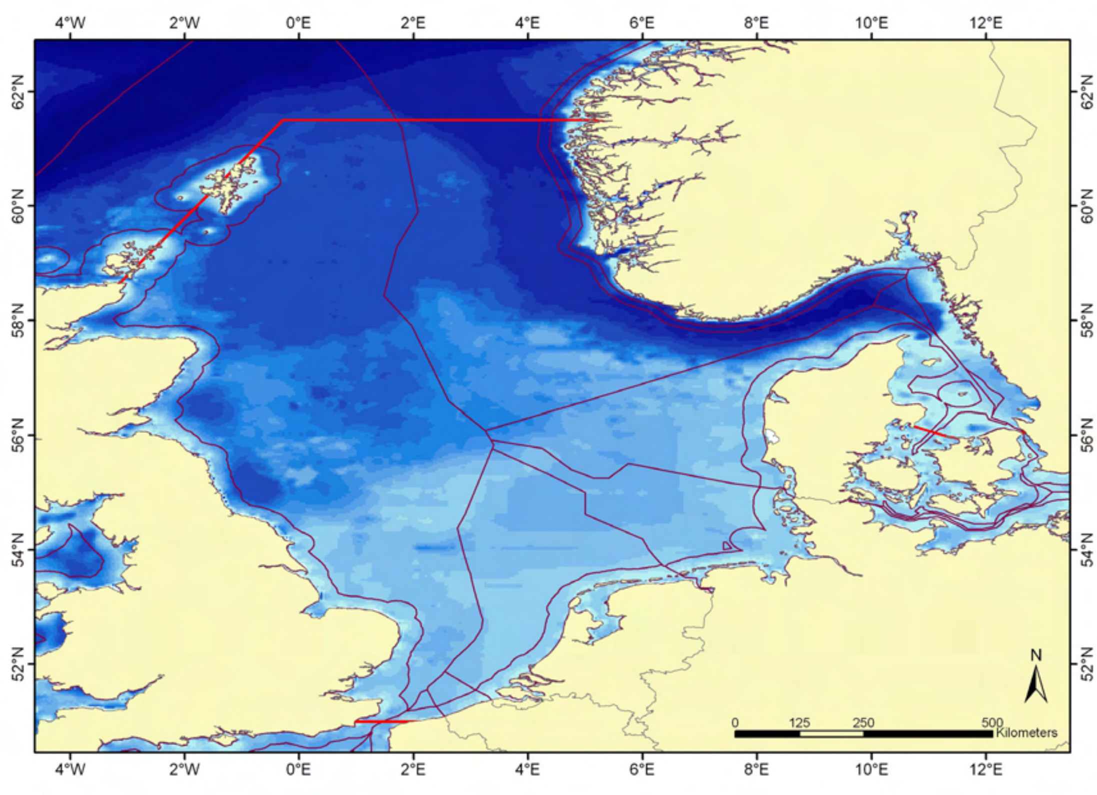
For a map we need to include the basic data layers, (i.e. a bounding box, coastline, bathymetry, "political boundaries")

Other derived layers may include fauna, surface sediments, contaminants, various pelagic determinands etc.

What basic data do we have already?

- Neil Golding has a bounding box for the North Sea (NS). Biogeographic regions identified by JNCC. Should we go for political or biological boundaries?

John Alvsvag has a NS "mega habitat map" with some bathymetric and sediment data. EEZ lines define sea areas at one level. We suggest that the northern limit should be 61° 30' N and the southern limit (Dover) 51° N, and 13° E and western limit will be a line that starts at John o' Groats, and runs at a roughly 45° angle through the Shetlands to 61° 30' N. A possible modification to this area is mentioned later in this annex.



MESH is aiming to provide a habitat map for this area and far wider over 3 years (but this will not cover many eastern parts of the NS, particularly Scandinavian waters). This will involve mainly existing data, with some method testing which will rely on new data.

The EEA are also producing a holistic habitat map of the NS which will be a top down approach fitting EUNIS classifications (See Kjell Norderhaug presentation in Section 5).

Dick de Jong has compiled a GIS (Habimap) which may supply a lot of data to, or possibly overlap, our own GIS (Craig Brown will contact him to see if we can use layers or data from this project).

What basic datasets exist?

Coastline

World vector coastline 1:250,000 is free. Probably OK but higher resolution may be useful.

Denmark – Has its own higher resolution coastline (1:25,000). Free via web.

Germany – Coastline data at 1:50, 000. Dieter Boedeker can find out if this is free.

Norway – Also has coastline at 1:50,000 but not sure if free (John Alvsvag).

Sweden has something similar to Norway for its own coastline.

Chris Cogan : Coastlines across Europe at higher resolution may not interface with each other. This may be a driver for choosing lower resolution free datasets.

Belgium – Has a 1:50000 version but might not be free outside Belgium (Els Verfaillie).

Eurocean: 1:?? Maps stable and unstable coastlines.

Holland has 1:10,000 and possibly 1:2,500 coastline.

France has 1:25,000 coastline.

UK – Has 1:10,000 via Ordnance Survey but this will cost.

Bathymetry

Geomorphology and water depth are the main drivers that define habitat. Therefore high resolution multibeam bathymetry (MB) is the best form of data for generating a basemap layer.

We need to ensure that datums match up when we patch datasets together.

Cmap – ??m resolution. Internationally available navigational maps but at a cost? Norwegian fishermen's bathy data have also been compiled from 62° N to 72° N.

Generalised bathymetry data from NOAA is available for free at low resolution (2 minute resolution).

BGS 1:250,000 bathy data for NS being released this year (Digmap), but will not be free. This data would be edge matched etc which would be important for any bathymetric dataset as we would not want to take this on ourselves. We will investigate the possibility of getting a lower resolution version from BGS that we could use for our purposes at no cost.

In Denmark there is a bathymetric dataset covering inner Danish waters at 200m resolution that we could use. Also Denmark have a dataset of the full NS area, but this is not available to us.

General question - Can we interpret expensive datasets and then remove the original layer which would ordinarily have to be purchased. Would this mean that we could utilise expensive datasets (BGS etc) at no cost?

In Norway, there are areas that have been surveyed using single beam bathymetry but also high resolution MB systems. John Alvsvag may be able to make it available? Are these more detailed MB datasets of use to us in our broad mapping objective? Yes, because we can use some of these smaller areas within our survey area which have been surveyed using MB, as examples of what can be achieved. We can demonstrate how the end product can be improved using higher resolution data. We should pick an area that demonstrates this to the greatest effect.

The ideal scenario is to have access to, or to produce a 100% MB survey of our area of interest. We know that this will not be possible so we will have to accept a lower bathymetric resolution.

JNCC EN + partners will be producing marine landscape maps from NS mid-line westwards. This will use BGS bathymetry and surficial data to produce interpreted maps which will be available to all.

Parts of the Swedish coast have been mapped at 5m resolution with MB (multibeam). We need to follow this up with Jacob Hagberg.

Belgian bathymetric data – They have single-beam data at 80 m resolution and some multibeam. Not available to us at the moment.

Mapping Scale

What scale should we be mapping at? What size of object do we need to resolve? A hard copy map for our area would have to be in the order of 1:1,000,000 or 1:500,000 to enable it to be produced in a useable sized sheet. A 1:50,000 map would only resolve objects of ~25m. We will aim to map to the highest resolution in small areas. The scale issue is something we will deal with along the way and will aim to be "fit for purpose". Fisheries questions will be better answered by maps at scales that may not be appropriate for other issues such as point source discharges. The NS would be mapped using a minimum mapping unit that would answer certain broadscale questions. We could insert higher resolution examples and could attach a list of possible additional questions that this scale of map could answer.

Chris Cogan – Presentation of the MAR_GIS project (Chris Cogan to supply PPT to David Connor).

This data is not all available for free but some sub-sets might be. Aim is to make it available. Data has been pulled from many different sources. Bathymetry point data covers our area of interest. Sediment maps use Folk classification system for our area (BGS, GEUS, RGD). Fish diseases, dissolved oxygen (1998–2002), Epibenthos (2000), salinity (1982–2002) temperature (1993–2002) primary production + many others.

Surficial sediments/geology

BGS data is licensed and only covers UK waters. CEFAS sediment map (John Cotter) covers whole NS but unclear as to what resolution (Dave Limpenny to check). German Hydrographic office holds paper records of sediment data in the German Bight. ICES has free sediment info on the NS area. UKHO also hold this paper data of fairly high res sediment data but this would take a lot of effort to get into acceptable format. This is not part of our remit. John Alvsvag has coastal sediment/geological data from Norwegian geological survey which is available in detailed patches and is free.

Danish classified sediment (1:500,000) data around Danish coast. Free to distribute after purchase and available on CD. Updated when data becomes available. Sub surface geology from Danish limited areas. There is a suggestion that BGS is involved in a compilation of surface sediment/geological data for the NS (Dave Limpenny to speak Ceri James).

General Point - It is not our job to compile datasets of any type we will just take datasets and post them on our GIS.

International boundaries can be bought from Veridian at $1,000. Can go to UN website and get free X,Y data. Are there other sources of this data? Metoc were asking for £3,000 for territorial limits.

Anthropogenic activities should also be inserted as a layer. Aggregate extraction, dredged material disposal, windfarms, oil pipelines, MPA's, SAC's (proposed and existing etc. OSPAR should have this data, Dieter Boedeker is the contact) fibre-optic cables, oil and gas structures. CONTIS provide this kind of data for Germany but might be wider.

Dutch have data on fisheries efforts and locations. Also future deep gas and oil resources.

Possible source of data. International Conference on the Protection of the NS, Progress Report, 2002. Ned to assess the utility of this document as a data pointer.

Dieter Boedeker – Presentation (Dieter to provide selected shots of this ArcView presentation)

Study of offshore ecologically sensitive areas in NS and Barents Sea. No bathymetry to start with but eventually got bathymetry from geological survey at 5m resolution. 2002 requirement to identify sandbanks and stony reefs and consider presence of any species on Annex II of the habitats directive. Information on sediment distribution from 1980's and interpreted for this specific purpose (Cheap to buy the map but the data may cost). This provided information on and location of, stone reefs. Extensive infaunal sampling across this survey area by Alfred Wegner Institute in 1998 provided species data. This generated a habitat map which provided guidance for the location of Natura 2000 sites. In 2002 an aerial survey of Harbour Porpoises was carried out and fed as a layer into the GIS. National Institute for Fisheries also mapped river Lamprey populations and input this data to the GIS. Sand banks were also identified but could not identify all sandbanks, as the bathymetric data was insufficient. Potential stony reefs identified by sediment map were surveyed by sidescan sonar and UWTV to confirm their nature. All of this data was input into GIS and areas of sensitive species (Porpoises etc) were mapped and their association with sediment, depth etc was mapped.

Danes are going to do something similar under Habitats Directive using existing data.

What scientific datasets would be valuable as layers for the GIS/Map?

Infauna

1986 and 2002 North Sea Benthos survey. 1986 survey reported in ICES J. Mar Sci 49: 127 – 143, 1992. 2002 survey data should be available in a few months.

Diversity and community structure of epibenthic inverts and fish in the NS. Ruth Callaway *et al*, 2002.

Mafcoms 2003 – 2004 – Greenstreet . Epifaunal/Infaunal and sediment survey using 2m Beam Trawls grabs.

Much other faunal data exists with the coastal zones of all countries. This can be drawn upon as required or if it's easy. Where this data falls within areas were the baseline data is of a high resolution then this could be targeted.

International bottom trawl survey. (Stuart Rogers CEFAS, FRS – Aberdeen). Young fish survey using 2m beam trawls is carried out annually in NS (CEFAS and others).

Temporal data exists for specific sites within the area (NMMP).

Strategic Environmental Assessment data held by UK, Dti.

Oceanographic data

What kind of data should we include. Min and max annual values, mean values for things like temperature, salinity, O2, nutrients, chlorophyll, currents (inc residuals), wave exposure, turbidity etc. All these determinands and more can be derived from the EEA. Stratification, NSTF should provide residence time for water bodies. Wave data can be provided by CEFAS Waverider buoys.

Fisheries Data

Stick with fishing effort for now as we are limited in our capability to include all fisheries data. Effort is important and measurable in the NS and impacts can be linked to other benthic data.

Satellite Data

Chlorophyll, surface temperature and turbidity data could be useful as interpreted layers. We can look at other sources than ESA (SeaWIFS) throughout the year.

General points

Explore data sources throughout the year

Members of the team will divide the load

Data will be made GIS friendly before it goes to our GIS expert (Kerstin Geitner)

Kerstin will work with Chris Cogan to disseminate data.

Docs of benthic habitat interest will be supplied to the IMS which will be managed by Chris Cogan. If others outside of the sub-group have useful docs they should also be supplied to Chris.

We will provide access to publications o the website. PDFs or refs.

Locate window sites for higher resolution data. Maybe aggregate extraction sites in NS (Kwintebanke, Area 222). One site needs to be inshore to balance an offshore example.

Objective. By this time next year our objective will be to investigate and load a first cut of layers into the GIS. These layers will be those that we feel are useful:

1) Coastline
2) International boundaries (EEZ and territorial)
3) Bathymetry (higher and lower resolution)
4) Substrate. Best where there is multibeam data.
5) Fauna and flora (*Lithothamnium*). Infauna, Epifauna. Different levels of spatial density, temporal.
6) Limited fishing data (effort)
7) Distinct habitat building fauna (*Lophelia*, mussels, *Sabellaria*).
8) Oceanographic (Temperature/Chlorophyll/Salinity/Wave Height)
9) Satellite derived data. Temp, colour, turbidity etc.
10) How do we collate and disseminate the GIS? Chris Cogan offered to disseminate via IMS server. Gratefully accepted.

Kerstin Geitner has volunteered to run the GIS and accept datasets via an FTP site. We will provide docs and data of interest and layers for a GIS.

We are depending on <u>all</u> members of WGMHM to advise on potential duplication of effort. We will hopefully ID gaps in existing data and where money could be spent to fill them.

Contacts within EEA and MESH and ICES to ensure we don't duplicate effort in data collection. MESH contact is Neil Golding and Kjell Magnus in the EEA. Will also communicate closely with Johnny Rekker (DK) as they will be producing high resolution data now and in the near future.

Discussions between members of the group will further define the extent of the map. Should we map the non-MESH part of the North Sea or should we concentrate on the eastern part? Should it be a demonstration of different resolution maps? We will follow this up with group members and specifically with the Danish members who may be able to make available high resolution data.

Annex 14 Mapping seabed habitats in UK waters

Mapping seabed habitats in UK waters

Practical Acoustic Ground Discrimination Workshop
6-11th September 2003

Workshop Report

SCOTTISH
ASSOCIATION
for MARINE
SCIENCE

2003

Mapping seabed habitats in UK waters

Practical Acoustic Ground Discrimination Workshop
6-11th September 2003

Workshop Report

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Contents

Executive Summary

In recent years the application of acoustic mapping methodologies, in particular the use of acoustic ground discrimination systems (AGDS) used in conjunction with ground-truth sampling, has become common practice in monitoring and mapping seabed habitats at a number of Special Areas of Conservation (SACs) around the UK coastline. Whilst this approach offers advantages over more traditional style benthic grab surveys, the accuracy of the spatial distribution maps produced from such surveys has on occasions been questionable.

Previous investigations into the application of AGDS have gone some way to assess the benefits and limitations of such systems for continuous coverage seabed mapping. The findings from many of these previous studies were used to develop procedural guidelines for conducting AGDS surveys which are presented as part of the Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook. However, as the number of research/contract groups undertaking broad-scale seabed mapping activities at various sites around the UK coastline increases it is essential to improve communication between these groups and to further refine guidelines and recommendations on best practice for the production of full-coverage seabed biotope maps using AGDS. To address these issues a UK National Acoustic Ground Discrimination Workshop was hosted by the Scottish Association for Marine Science at Dunstaffnage Marine Laboratory from 6-11th September 2003.

The workshop brought together a number of UK research/contract groups who use the AGDS, RoxAnn, for the production of biotope maps. The main aim was to critically evaluate this acoustic system for use in mapping seabed biotopes. A small test site on the west coast of Scotland, within the Firth of Lorn candidate SAC, encompassing a wide range of benthic habitats was chosen as the study site. Prior to the workshop, the area was surveyed using sidescan sonar to accurately map seabed features and two contingency RoxAnn data sets were collected. Ground-truthing using a drop-down video system was also carried out at various sites across the area for the purposes of external validation of the final habitat maps. The first two days of the workshop were held at sea and participants were invited to apply their own mapping methodology over this study area using at least 2 separate RoxAnn systems. Issues such as survey design, system set up and data quality assessment were addressed. A common ground-truthing data set (underwater video data) was

also collected from within the test site during this time, and issues relating to the selection of ground-truthing stations were discussed.

The common ground-truthing data set was then used during the processing of the RoxAnn data sets back at the laboratory during a 2-day data-processing workshop. Workshop sessions were run covering various aspects of data handling, quality assessment and data processing to review methods of best practice. Spatial coverage maps were produced from each of the RoxAnn data sets and the accuracy and predictive capability of each map was then tested against the external ground-truthing data set collected prior to the workshop. A total of four different RoxAnn data sets were collected and processed during the workshop to assess aspects such as between-system variability, survey design and data quality.

The final session of the workshop was open to all interested parties within the UK; the primary focus of this session was to present the findings of the workshop to non-specialist environmental managers/advisors involved in the implementation and end use of biotope maps. Issues relating to accuracy, predictive capability and system limitations were discussed to provide a better understanding of this type of mapping approach to non-specialists who regularly use the out-puts from such surveys.

Comparisons between the four maximum likelihood classification maps produced from the four RoxAnn datasets collected was done using internal and external accuracy assessment techniques based on the video ground-truth data sets. These results revealed a moderate level of agreement in terms of the spatial distribution of the six habitat classes (life-forms) identified within the study area between the four data sets. The ability of the RoxAnn system to identify discrete seabed features mapped using sidescan sonar was also tested. RoxAnn consistently overestimated the percentage of rocky reef habitat and underestimated the percentage of mud habitat within the area compared to that measured by sidescan sonar. A number of recommendations relating to the use of AGDS for the production of continuous coverage maps and relating to the JNCC Marine Monitoring Handbook guidelines are proposed.

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1. Background

Maps which show the distribution of habitats and biota, together with accompanying data and statistics, are central to many aspects of environmental appraisal, in particular for use in the assessment of the natural heritage (conservation) and the impacts of human activities on biological resources of the seabed. Recent developments in seabed mapping techniques, driven by continuous improvements in acoustic systems (e.g. side-scan sonar, multibeam sonar, acoustic ground discrimination systems), offer the potential to radically alter approaches to monitoring and mapping this component of the marine ecosystem. In recent years the application of acoustic mapping methodology (in particular the use of acoustic ground discrimination systems – AGDS), used in conjunction with ground-truth sampling, has become common practice in monitoring and mapping seabed habitats at a number of Special Areas of Conservation (SACs) around the UK coastline (e.g. Davies 1999; Foster-Smith and Sotheran, 1999; Foster-Smith et al 1999, 2000; Service 1998; Service and Magorrian 1997). Whilst this approach offers advantages over more traditional style benthic grab surveys, the accuracy of the spatial distribution maps produced from such surveys has on occasion been questioned.

There have been a number of previous investigations into the application of AGDS which have gone some way to assess the benefits and limitations of such systems for continuous coverage seabed mapping (Anon 2000; Foster-Smith and Sotheran 2003; Foster-Smith et al. 1999; Greenstreet et al. 1997; Hamilton et al. 1999; Hull and Nunny, 1998; Magorrian et al. 1995; Pinn and Robertson, 1998 and 2003; Wilding et al. 2003). Many of the issues addressed during the current workshop (e.g. effects of vessel speed, variability between systems, line spacing etc) have been investigated in detail in a number of the studies listed above, and many of these findings were used to develop procedural guidelines for conducting AGDS surveys which are presented as part of the Joint Nature Conservation Committee (JNCC) Marine Monitoring Handbook (Foster-Smith et al, 2001a). However, as the number of research/contract groups undertaking broad-scale seabed mapping activities at various sites around the UK coastline increases it is essential to improve communication between the groups and to further refine guidelines and recommendations on best practice for the production of full-coverage seabed biotope maps using AGDS. This would help to further evaluate the utility of such acoustic systems for the production of seabed habitat maps.

This workshop aimed to address some of these points by bringing together UK research/contract groups who use the AGDS, RoxAnn, for the production of biotope maps. The workshop aimed to compare and contrast mapping methodology and ultimately biotope maps produced by each group over the same area of seabed using the same research vessel. Existing guidelines (Foster-Smith et al, 2001a) were used as the basis for the workshop and discussions were held to address the various aspects of AGDS survey from data collection through to the production of habitat maps.

Details regarding how AGDS work and information relating to the various post-processing methods are covered in detail elsewhere (Foster-Smith et al., 2001a and b; Foster-Smith and Sotheran, 2003) and will not be covered in this report. This report will focus on presenting discussion points raised during the various stages of the workshop from data collection through to final map production, and will compare and evaluate the habitat maps produced during the course of the workshop.

2. Structure of the Workshop

The workshop aimed to critically evaluate the use of the Acoustic Ground Discrimination System, RoxAnn, for use in mapping seabed biotopes. A small test site on the west coast of Scotland within the Firth of Lorn candidate SAC encompassing a wide range of benthic habitats was chosen as the study site (Figure 1). Prior to the workshop, the area was surveyed using sidescan sonar to accurately map seabed features and two contingency RoxAnn data sets were collected. Ground-truthing using a drop-down video system was also carried out at various sites across the area for the purposes of external validation of the final habitat maps.

A number of research/survey teams working with the AGDS RoxAnn were invited to participate in the workshop. Participants were asked to apply their own mapping methodology over this study area using at least 2 separate RoxAnn systems during a 2 day data collection workshop at sea. Issues such as survey design, system set up and data quality assessment were addressed. A common ground-truthing data set (underwater video data) was also collected from within the test site during this time, and issues relating to the selection of ground-truthing stations were discussed.

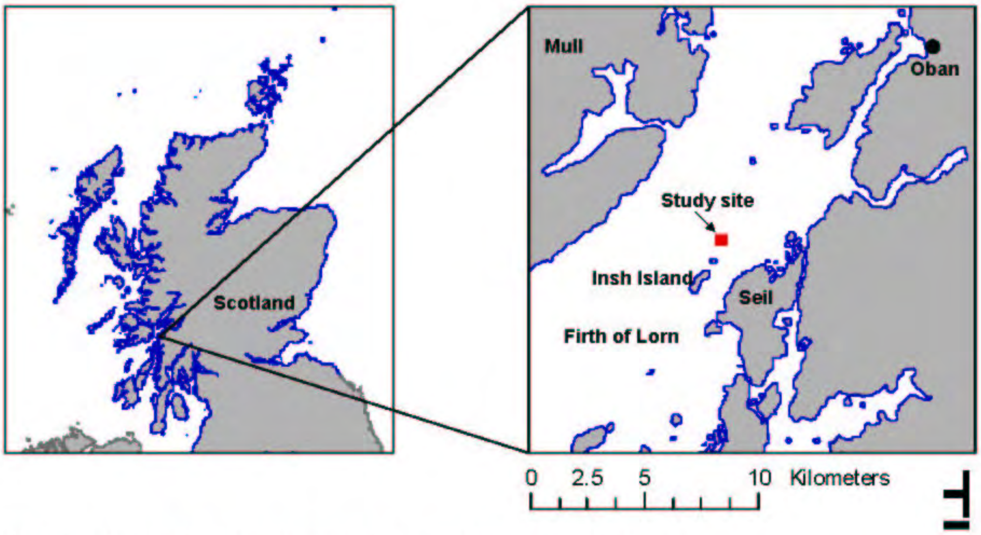

Figure 1. Location of the study area, Firth of Lorn, Scotland

The common ground-truthing data set was then used to process the RoxAnn data sets back at the laboratory during a 2-day data-processing workshop. Workshop sessions were run covering various aspects of data handling, quality assessment and data processing to review methods of best practice. Spatial coverage maps were produced from each of the RoxAnn data sets and the accuracy and predictive capability of each map was then tested against the external ground-truthing data set collected prior to the workshop. A total of four different RoxAnn data sets were collected and processed during the workshop to assess aspects such as between-system variability, survey design and data quality.

The final session of the workshop was opened up to all interested parties within the UK; the primary focus of this session was to present the findings of the workshop to non-specialist environmental managers/advisors involved in the implementation and end use of biotope maps. Issues relating to accuracy, predictive capability and system limitations were discussed to provide a better understanding of this mapping approach to non-specialists who regularly use the outputs from such surveys.

Workshop objectives:

- To compare the reliability of the AGDS RoxAnn, for the production of full spatial coverage maps of seabed habitats and biotopes, through comparison of the outputs from a number of different RoxAnn systems over the same area of seabed.

- To compare and evaluate different approaches to seabed mapping between different research teams within the UK, with the aim of identifying and standardising best practice.

- To assess the predictive capability of biotope maps produced using RoxAnn through the collection and application of an external ground-truthing data set.

- To report on the significance of the findings for the management and monitoring of SACs.

- To provide a better understanding to non-specialist environmental managers/advisors of the techniques and data processing methodologies involved in the production of full-spatial coverage biotope maps produced using the AGDS RoxAnn, and to highlight potential benefits/limitations of biotope maps produced in this way.

Research groups:

Representatives from six research teams/organisations attended the workshop, namely: Scottish Association for Marine Science (SAMS); Department for Agriculture and Rural Development, Northern Ireland (DARD); Queens University, Belfast; Fisheries Research Services, Aberdeen (FRS); Centre for Environment, Fisheries and Aquaculture Science (CEFAS); Joint Nature Conservation Committee (JNCC). Unfortunately, two key research teams were unable to attend the workshop and as a result a number of data processing issues were not discussed to the degree anticipated. However, the workshop allowed comparison between the data sets collected allowing valuable evaluation of survey designs proposed by each research team.

This report incorporates points raised during the open-session on the final day of the workshop.

3. Workshop findings/discussion issues

The following sections present the methodology adopted and the discussion points covered by the workshop participants (WP) during the course of the workshop, and the structure of the report broadly follows that used in the JNCC Marine Monitoring Handbook (Foster-Smith et al, 2001a). Conclusions from each of the discussion issues are listed at the end of each section.

3.1 Equipment and set up

Two vessels were used during the course of the workshop. The RV Seol Mara was used to collect data prior to the workshop, and the RV Calanus was used during the two day data collection exercise as part of the workshop (Figure 2). Both vessels provide an adequate platform for conducting AGDS surveys as specified in the JNCC Marine Monitoring Handbook (Foster-Smith et al, 2001a).

Figure 2. RV Calanus and RV Seol Mara

Two RoxAnn systems were used during the workshop, both operated at 200kHz which was agreed by all WP to be the most suitable frequency for the water depths encountered at the survey site (15-60m). Both systems came complete with transducer and RoxAnn signal processor. The data logging software *RoxMap* was used to log the data throughout the course of the workshop, and an agreed power

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setting and save rate was used during all data collection to eliminate the effects of these parameters on the final habitat maps (Figure 3).

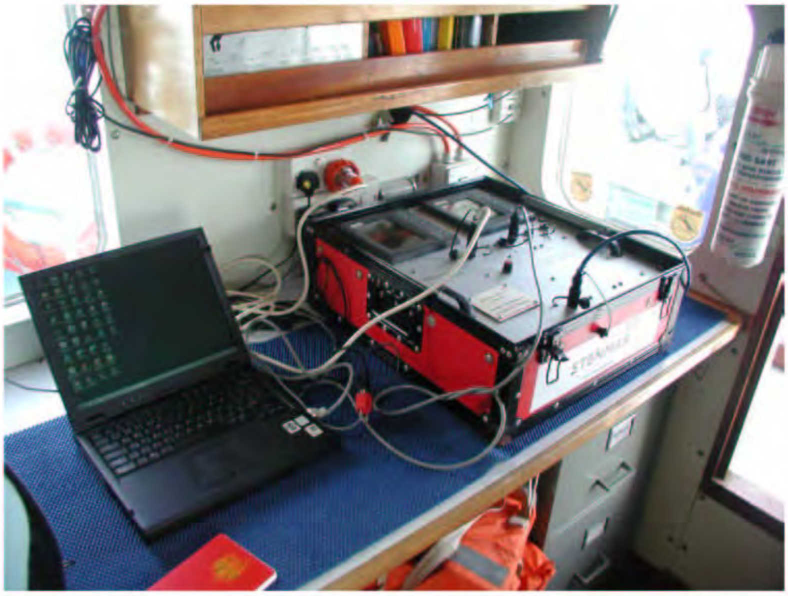

Figure 3. RoxAnn signal processing unit linked to a laptop recording the data using the data logging software RoxMap.

On both vessels an over-the-side mount was used to deploy the transducer(s) (Figure 4). This is the commonest method of deployment for portable RoxAnn systems, especially from smaller vessels, and there was agreement amongst the WP that this is an adequate method of deployment as long as the mounting pole is stable at working speed, that there are no signs of aeration beneath the transducer, and that the transducer protrudes below the hull of the vessel to avoid multipath interference. A number of WP also raised the issue of permanent hull-mounted transducers, which are often used when conducting surveys from larger vessels. Such system configurations offer a very stable mounting for the transducer, although fouling of the transducer face could affect data quality and the gradual build-up of material on the transducer over time could affect survey repeatability. This is an unavoidable consequence of permanent hull-mounted systems and regular cleaning of the transducer by diver or dry-docking is the only way to limit problems arising from the build-up of bio-fouling.

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Differential GPS was used on both RV Seol Mara and RV Calanus. In both cases the GPS antennae was positioned directly above the transducer to minimise heading error. This was agreed by all WP to be the preferable set up, although it should be noted that this configuration may not always be possible, particularly when the vessels own GPS system is used.

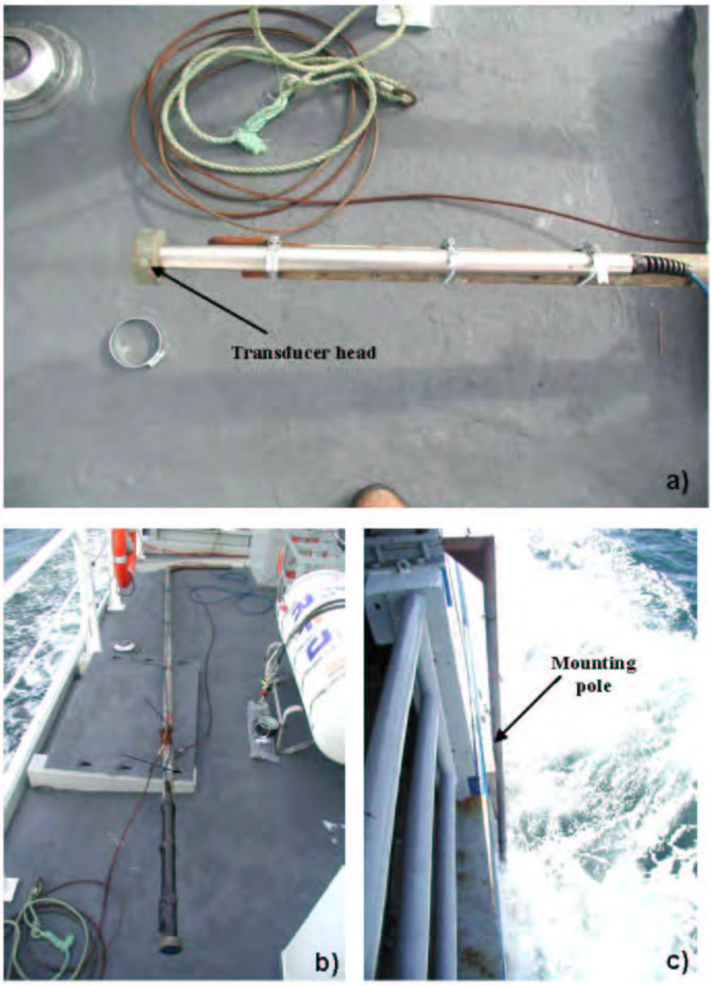

Figure 4. a) RoxAnn transducer attached securely to the over-the-side mounting pole; b) Mounting pole from RV Calanus prior to deployment; c) Mounting pole on RV Calanus following deployment.

There are a wide range of ground-truthing options open to surveyors of which the pros and cons have been discussed at length in previous studies (see Foster-Smith

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et al. 1999, 2001 a and b; Brown et al. 2001). By far the most popular technique for ground-truthing AGDS data sets is underwater video as this provides a rapid means of collecting a large number of field samples which is crucial for the production of biotope/habitats maps using AGDS. Video also permits the observation of conspicuous sea floor characteristics at a scale appropriate to the echo-sounder footprint. It is also an appropriate method for collecting data over a range of seabed types in contrast to other techniques which may be limited in their application to specific seabed characteristics (e.g. grab sampling is limited to regions of softer sediments and can not be used effectively on rocky or consolidated substrates). However, it should be noted that in regions of poor visibility, or where strong currents prevail, the application of video ground-truthing may not be suitable and in such locations it may be necessary to employ other ground-truthing techniques.

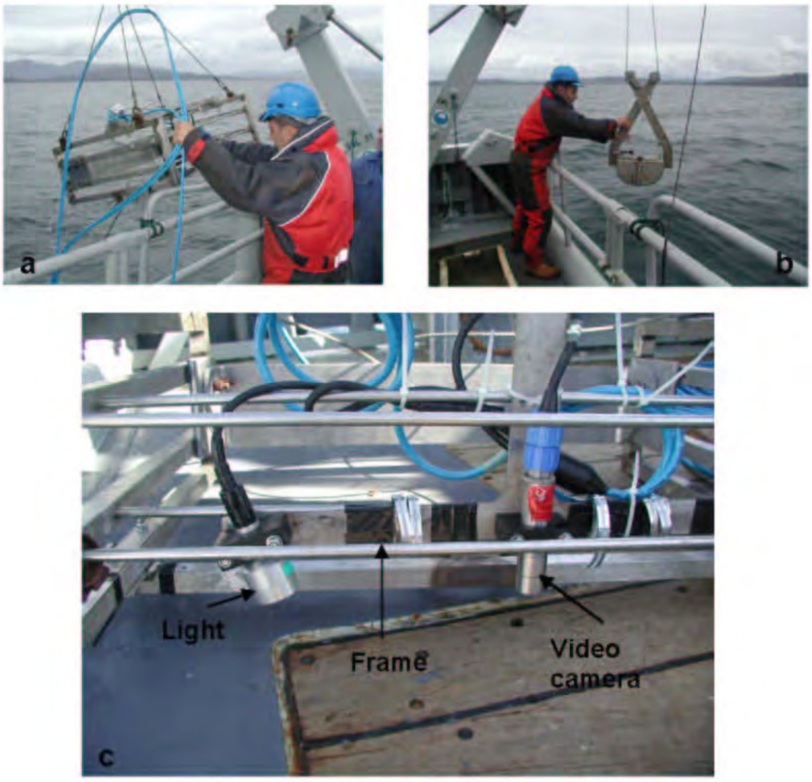

Figure 5. a) Deployment of drop camera frame from RV Calanus; b) Deployment of Van veen grab from stern of RV Calanus; c) Video camera and lights attached to the drop frame.

It was universally accepted amongst the WP that video was the most appropriate technique for use at the survey site, and therefore a drop-down video system was used (Figure 5). The system was deployed from the stern of the research vessel and was suspended approximately 1-2m above the seabed to obtain images of surficial sediments, seabed features and conspicuous epifauna. WP also discussed the benefits of using more than one ground-truthing method to assist in defining biotopes from the video footage. It was agreed that this would be a beneficial approach and a limited number of grab samples using a Van-veen grab (Figure 5) were collected at selected sampling locations.

Conclusions:

- WP felt that the recommendation laid down in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) relating to equipment set up and data collection procedures were, on the whole, comprehensive and sufficiently detailed.

- Survey sites and survey requirements can vary widely and WP agreed that a degree of flexibility needs to be retained in the guidelines to allow informed decision by the surveyor regarding the choice of AGDS system, system configuration, and selection of ground-truthing techniques on a survey-by-survey basis. The guidelines as they stand are sufficiently flexible to meet this requirement.

3.2 Survey design and data collection

Survey design:

Four RoxAnn data sets were collected during and prior to the workshop which were consequently used in the data processing exercises (see later). Each participating research group was given the opportunity to design a survey which they deemed appropriate for the study area. The aim of this was to examine the difference between biotope maps produced from surveys conducted by different research teams using different survey strategies (e.g. line spacing, track orientation etc.). Two of these survey strategies were adopted for use during the workshop: A north-south survey line design with track spacing of approximately 100m; and an east-west survey line design with track spacing of approximately 70m (Figure 9). Track spacing was chosen based on the time available for the survey, information taken from hydrographic charts, and prior knowledge relating to the heterogeneity of the seabed in the region from earlier studies in the vicinity of the Firth of Lorn (Davies, 1999). The decision regarding track orientation was based on weather constraints and personal preference. Track plots are shown in black in Figure 9.

The JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) lists recommendations regarding survey design which are sufficiently flexible to accommodate the wide variety of seabed characteristics likely to be encountered during surveys, and to accommodate decisions relating to survey design which may arise as a result of weather constraints, operational restrictions or a lack of knowledge about the site. The WP felt that the guidelines regarding this issue were sufficiently detailed as they currently stand. In the current exercise the variability in design between survey teams would allow the effect of survey design on final map production to be assessed.

Working speeds of 7-8 knots for AGDS surveys are quoted in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a). In theory vessel speed, within reason, should have little if no effect on data quality and should only affect the intensity of data points on the seabed. The decision as to what speed a survey should be conducted will depend on factors such as the nature of the survey vessel being used, the stability of the transducer mounting and the sea state. Many of these parameters will vary between surveys and the final decision as to what speed the survey vessel should be run will come down to the surveyor on the day of the survey. During the current workshop three survey speeds were adopted; one of the survey grids was run at 4 knots, two of the survey grids were run at 6 knots, and the remaining survey grid was run at 8 knots. These were agreed by the WP to be a representative range of survey speeds commonly used when collecting AGDS data and would allow the effect of vessel speed on the final habitat map to be assessed.

Quality assurance issues relating to data collection and the maintenance of data quality during the field survey were discussed by the WP. Measures which should be adopted to ensure data quality are covered in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) and the WP felt that these were sufficiently detailed and comprehensive. During the workshop these guidelines were adhered to. Data collected during the workshop was logged using the software *RoxMap*.

The following table summarises the various parameters relating to the four RoxAnn data sets that were collected:

	Research vessel	Track orientation	Vessel speed	RoxAnn system	Track spacing
Data set 1	RV Calanus	North-south	4 knots	200kHz system (SAMS)	100m
Data set 2	RV Calanus	North-south	8 knots	200kHz system (SAMS)	100m
Data set 3	RV Seol Mara	East-west	6 knots	200kHz system (SAMS)	70m
Data set 4	RV Seol Mara	East-west	6 knots	200kHz system (Stenmar)	70m

Table 1: Summary of the survey parameters associated with the four RoxAnn data sets.

A sidescan sonar survey was also conducted at the site from RV Seol Mara prior to the workshop. An Edgetech 272 sidescan sonar fish, operating at the 100kHz frequency setting, was used to image the seafloor at the study site, with data logged using an Octopus™ 460 data acquisition system. Sidescan sonar fish approximate layback was logged manually from the length of cable deployed and water depth, and an average layback applied to the data prior to data processing. A mosaic of the sidescan sonar data was produced using CodaOctopus™ mosaicing and editing software in order to produce a spatial image of the seabed features within the study area (e.g. rocky reefs, regions of soft mud) (Figure 6).

The sidescan sonar mosaic could be divided into three acoustically distinct regions with confidence. Rocky reefs were clearly discernable and were characterised by a strong acoustic reflectance and regions of acoustic shadow. These features could be mapped to a relatively high level of accuracy (Figure 7). Regions of low acoustic reflectance (probably relating to regions of soft mud and muddy sand) could also be identified and delineated, although this habitat did not always have distinct boundaries and there was therefore a degree of subjectivity as to where the boundary was placed. For the purpose of the workshop these two acoustic regions were classified with life-form categories used in the RoxAnn classification, namely MCR/MIR for the rocky reefs and CMU for the low reflective regions (see section 3.3). The region between these two classes had an intermediate acoustic reflectance

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and could not be classified with any confidence into any of the life-form classes used for the RoxAnn classification. It is likely that this intermediate region contained a number of different life-forms. However, identifying two acoustic regions from the sidescan sonar data which could be loosely linked to discrete life-form classes offered another means against which to test the predictive capability of the RoxAnn maximum likelihood maps (see section 3.3), although the aim of this exercise was not to make comparisons between AGDS and sidescan sonar as tools for mapping seabed habitats.

It should be recognized that there is a degree of positional error associated with the sidescan mosaic as a result of the layback between the sidescan sonar fish and the dGPS receiver on the research vessel, and that comparisons between the AGDS maps and the interpretation of the sidescan sonar mosaic are relative with respect to these positional errors.

The selection of appropriate ground-truthing sites is crucial for the production of good-quality habitat maps. The JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) offers a comprehensive list of recommendations for the selection of sites which the WP felt were adequate for ground-truthing AGDS data. Nonetheless, the selection of ground-truthing stations can still be problematic, particularly in regions where the sea floor is heterogeneous in nature.

During the workshop 16 drop-down video stations were sampled for the purposes of signature development, and 10 drop-down video stations were sampled for the purpose of accuracy assessment (Figure 8). The JNCC guidelines were adhered to as closely as possible. The WP felt it was also necessary to use a second ground-truthing technique to confirm the nature of several types of sediments recorded during the video dips. A Van-veen grab was therefore deployed at seven stations to collect sediment samples. These were examined on deck to confirm sediment characteristics from the video data.

The logging of positional information relating to the ground-truthing data was an issue that the WP discussed at length, and this topic is poorly covered in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a). There are several ways by which this can be done and the selected approach will have a significant effect on accuracy. The simplest method when using video and probably the most commonly used approach (and the approach used during the current workshop), is to log the vessels

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position and relate its location to the video data by time. This approach is adequate when working in shallow waters when the video system is likely to be directly below the vessel. This approach can be improved by incorporating an overlay onto the video screen displaying vessel position, vessel heading, station number and time. However, in deeper waters, or when using towed camera systems there is undoubtedly a layback between the vessel and the location of the camera on the seabed. In such situations a positional error is inevitable. In regions of homogeneous substrata this may not cause any major concerns, but in regions where the seabed has a degree of heterogeneity the difference in position between the vessel and the camera can reduce the accuracy of the final habitat map. In such situations it is advisable to use an underwater positioning system/beacon attached to the underwater camera.

Conclusions:

- WP felt that survey design and data collection recommendations laid down in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) were, on the whole, comprehensive and sufficiently detailed.

- Positional accuracy was flagged up as one of the most crucial requirements for both AGDS and ground-truth data collection. Positioning the GPS antenna above the transducer reduces positional error when logging the RoxAnn data. On vessels where the GPS antennae is not directly above the transducer it should be noted that there will be a positional offset between the logged position of each acoustic return and the actual ensonified area of seabed.

- It was agreed that the recommendations for ground-truthing AGDS data sets as laid down in the JNCC Marine Monitoring Handbook were appropriate and sufficiently flexible to allow the surveyor to make informed decisions regarding the type of sampling gear and method of deployment. However, it was felt that quality issues relating to video data and positional accuracy of data should be raised. This is referred to in the JNCC guidelines but its importance needs to be strengthened, particularly when using towed or drop down video systems in relatively deep water. Lay back issues can affect the quality and accuracy of the final habitat maps, especially where there is disparity between the accuracy of the AGDS data and ground-truthing data (see later). Ideally a underwater positioning system should be employed to accurately locate the

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camera system on the seabed. However, where cost or operational restraints prevent this every effort should be made to log the position of the ground-truth data as accurately as possible.

- The quantity of ground-truthing data was also raised by WP as an issue of concern. Ground-truth data is used in subsequent data analysis and accuracy assessments and should be of sufficient quantity to serve both purposes. tFoster-Smith et al. (1999) discuss this issue at length, and whilst it is not possible to be prescriptive as to the minimum number of ground-truthing data points as this is greatly affected by the degree of homogeneity of the seabed, it should be strongly pointed out that increasing the number of ground-truthing stations will strengthen accuracy of the final habitat map and improve the ability to assess the accuracy of such maps.

Figure 6. Sidescan sonar mosaic of the Firth of Lorn study site. Grey-scale: Dark regions are reflective/hard.

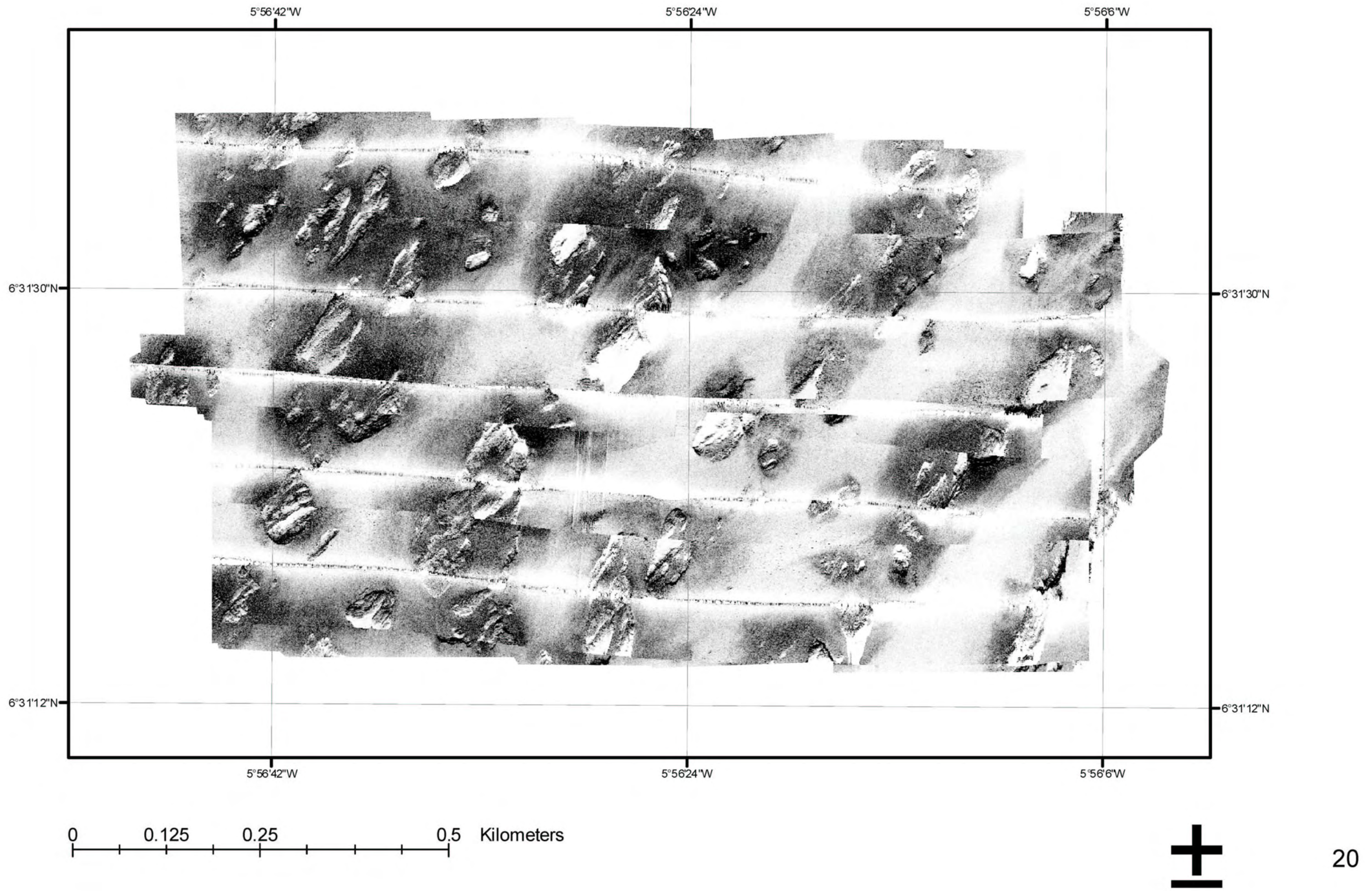

Figure 7. Sidescan sonar interpretation: Strong acoustic return and regions of shadow - Rocky reefs (MCR/MIR); Low acoustic return - Circalittoral mud (CMU); Intermediate acoustic return – unclassified region between rocky-reefs and regions of mud.

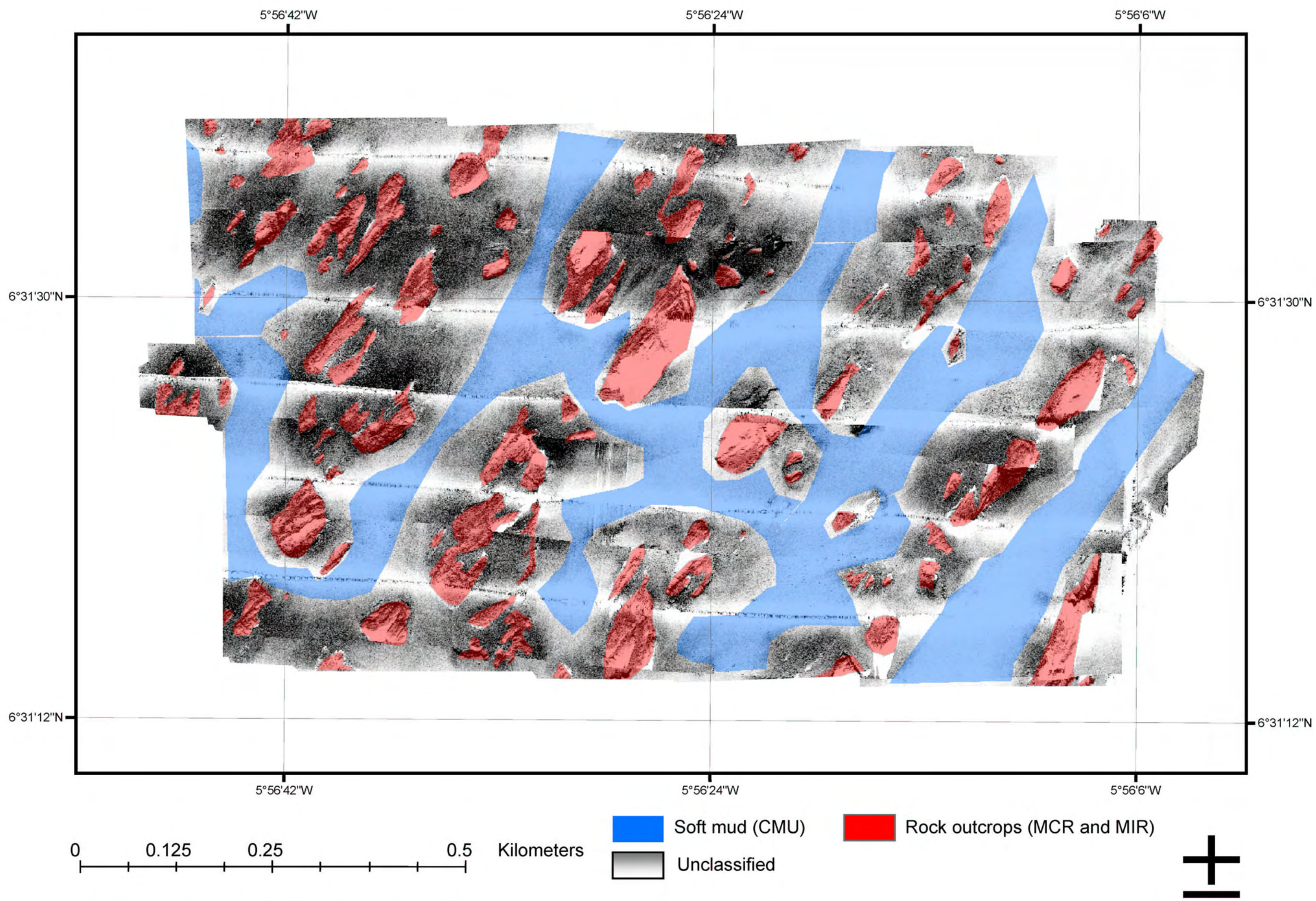

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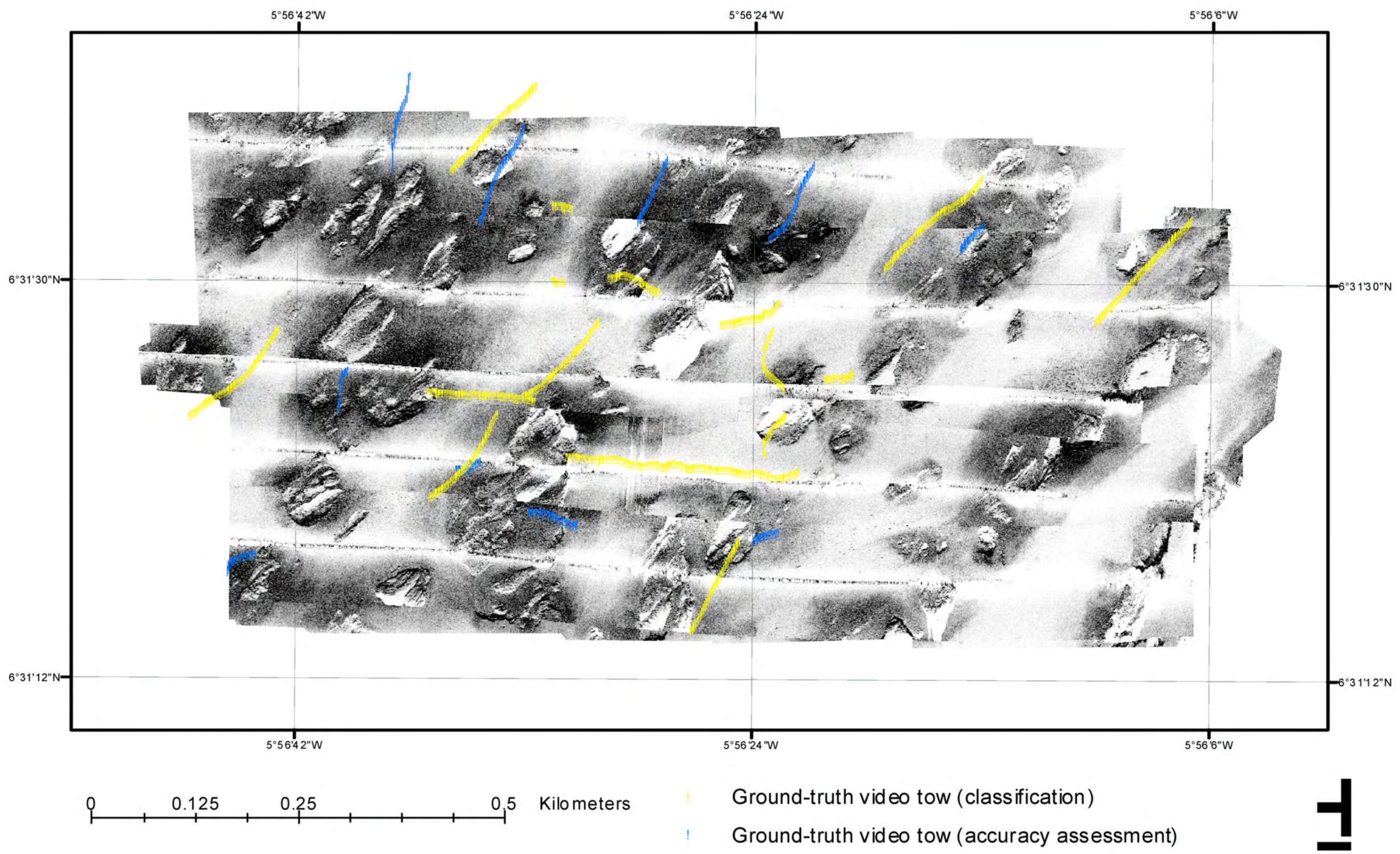
Figure 8. Video ground-truthing deployments overlaid on the sidescan sonar mosaic.



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3.3 Data Processing

All data was processed using the same methodology, following the approach described by Foster-Smith and Sotheran (2003), Foster-Smith et al. (2001b) and referred to in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a). This approach is widely, although not universally, adopted in the UK to process AGDS data. Whilst it is recognised that other research groups in the UK, who were unable to attend the workshop, may adopt different approaches, it was felt that based on the expertise available amongst the WP it would be beneficial to use a single standardised data processing approach. This would eliminate the influence of data processing procedures on the final habitat maps, and allow comparisons to be made based on factors such as survey design, vessel speed, vessel type and system to be assessed. Unfortunately however, the limited experience in alternative data processing approaches amongst the WP meant that these guidelines and procedures could not be further refined during the course of the workshop. The following therefore describes the data processing methodology adopted for analysis of the four AGDS data sets collected as part of the workshop:

Preliminary data treatment:

Each RoxAnn data set was subjected to data filtering and exploration procedures. A spreadsheet macro was applied to each data set which highlighted spurious data points based on sequential depth changes of more than 1.5 meters. These data points were then examined in a GIS using a non-Earth plot (e.g. Datapoint ID as x axis and depth as y axis) and removed when the change was unlikely to be 'real' (i.e. There was not a steep slope that would account for such 1.5m changes in depth). The macro also produced an acoustic variability index value for each data point. This was generated by square-rooting the absolute value of the next data point minus the current data point for each of E1 and E2, then adding these together. This provides a measure of along-track data variability for E1 and E2, which was used in later analysis. Scatter plots of E1, E2 and depth were also produced to check for dependencies between variables, and checks were made for navigation jumps using the GIS package, *ArcGIS 8.3*. No tidal corrections were applied to the data as surveys took less than 1 hour and it was felt unnecessary for the purposes of the workshop, although this would be recommended as general practice.

Variograms were produced using the software package *Surfer* surface mapping system in order to establish the degree of spatial correlation within each of the data sets and to establish the maximum distance over which interpolation was deemed to be appropriate. The reader is referred to Foster-Smith and Sotheran (2003) for a detailed discussion on preliminary data treatment procedures.

Interpolation:

As many of the seabed maps produced for marine SACs in the UK are continuous coverage maps, and in order to conduct supervised classification procedures on the data sets, it was necessary to conduct interpolation procedures on each of the data sets. Interpolation parameters were established from the variogram analysis and the same parameters (search radius size, interpolation technique etc.) were applied to each data set:

Pixel size:	$10m^2$ (determined from acoustic footprint combined with size of survey area)
Interpolation technique:	Inverse Distance Weighting to a Power of 2
Search radius:	150m (to correspond to the smallest sill distance from the four data set variograms)

For each or the four RoxAnn data sets E1, E2, acoustic variability (see above) and depth were interpolated using *Surfer* to give full coverage of the survey area. The survey area dimensions were kept the same for each data set, however, it should be noted that some of the RoxAnn survey tracks were quite far from the edge of the survey area in some of the data sets and therefore 'edge effects' occur in the interpolated grids. The interpolated data grids were used in subsequent classification procedures. The reader is referred to Burroughs and McDonnell (1998) and Foster-Smith and Sotheran (2003) for a detailed discussion on interpolation procedures.

Classification:

All classification procedures were carried out using the software package *Idrisi*. Interpolated data grids from each of the four RoxAnn data sets were imported into *Idrisi* to be saved as raster images. These images were stretched such that each pixel in the image was assigned a value of between 0 and 256, based on the magnitude of the original data value. The raster images for each of E1, E2, acoustic variability and depth were combined in a collection for each of the data sets, which were used for supervised classification.

Supervised classification is a three-stage procedure and the following steps were followed:

a) 'Training sites' were determined for use in acoustic signature development (see stage b). This was done based on ground-truthing data, which was in this case 16 of the drop down video stations. From the video footage six distinct seabed classes (Life-forms) were identified based on the National Marine Habitat Classification for Britain and Ireland Version 03.02 (internet version – Connor et al 2003). These were:

1) Circalittoral gravel and sands (CGS)
2) Circalittoral gravel and sands with boulders (CGS.B)
3) Circalittoral muddy sand (CMS)
4) Circalittoral mud (CMU)
5) Moderately exposed circalittoral rock (MCR)
6) Moderately exposed infralittoral rock (MIR)

Training sites were digitised in a GIS around areas of each video tow where each life-form was recorded. A small buffer zone was included to ensure sufficient data was included within each life-form class.

b) The training sites were used to develop acoustic signatures for each RoxAnn data set within *Idrisi*, which calculates the mean and range for each of E1, E2, acoustic variability and depth for each seabed class. This was done within the software by overlaying of the training sites onto the appropriate raster images and recording the mean and range of pixel values beneath each training site and storing this data as signature files.

c) A pixel classification method was then applied to the collection of raster images for each data set. Maximum likelihood classification was chosen as the classification method as it is universally acclaimed as the most satisfactory method (Baily and Gatrell 1995, Wilkie and Finn 1996, Eastman 1999). The Maximum Likelihood classification is based on the probability density function associated with a particular

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training site signature (Clark Labs, 2002). The acoustic signatures are used to calculate the likelihood of pixel membership to each seabed category. For each of the four RoxAnn data sets this was done using the above training sites and using interpolated E1, E2, acoustic variability and depth data, resulting in each pixel being assigned to the category to which it most likely belonged. This was the final stage in map production for each of the four RoxAnn data sets and resulted in four seabed maps classified in to the six life-forms.

The final maps in *Idrisi* were converted to vector files which could be exported as ESRI shape files for incorporation into ArcMap 8.3 GIS.

Conclusions:

- The WP agreed that AGDS data analysis is a vast subject and many routes can be taken through the process of data interpretation. It was recognised that different research/survey teams within the UK adopt different approaches but unfortunately it was felt that there was insufficient breadth of experience amongst the research teams who attended the workshop to compare and contrast a range of approaches. It was agreed though that guidelines on this subject need to be flexible to accommodate the end needs of the biotope maps. The JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) provides a 'loose' guide to this subject area, and in light of developing methodologies and ideas within this field it was felt by the WP that the guidelines as they stand are sufficiently detailed and allow a degree of flexibility.

- Whilst it was recognised by the WP that only one data processing approach was adopted, it was felt that under the limited time available during the workshop that adopting a single approach would be beneficial. It should be noted however that different data processing approaches will undoubtedly produce slightly different seabed habitat maps.

4. Comparison of biotope maps

Accuracy assessment:

On the whole the spatial pattern of the six life-forms presented in the four maximum likelihood maps (Figure 9) appear broadly similar, particularly the spatial patterns of the two rock life-forms (MCR and MIR) and the occurrence of the mud life-form (CMU). All four maps pick out the main regions of rocky reefs in similar areas of the survey site, and all indicate a roughly south-west to north-east orientation of features, particularly regions of muddy substrate.

Internal accuracy assessments were used to measure the match between ground validation data and the classified pixels (Table 2). This method shows a matrix of seabed classes (in this case life-forms) as identified at the ground-truth sample locations against the life-forms predicted from the AGDS data from the same location. This process was carried out using *Idrisi*, and the pixels within each ground-truthing buffer were compared with the same pixels from the classified maps. The highlighted diagonal cells within each matrix in Table 2 indicate an exact match between ground-truthing and map pixels. Comparing the exact match value with the row total provides an estimate of how accurately each life-form class was predicted, and which life-form classes were commonly confused (known as errors of commission). Similarly, comparing the exact match with the column total shows how many ground-truth pixels within each class fell within another mapped life-form class (known as errors of commission). The overall internal accuracy is calculated as the proportion of the sum of the diagonal values (exact match) against the total number of pixels (sum of column or row totals).

Internal accuracy assessments for the four RoxAnn data sets reveal a moderately high level of accuracy (Table 2). The map produced from the RoxAnn data set collected at 8 knots aboard RV Calanus showed the lowest overall internal accuracy (57%) which may be a consequence of fewer data points collected during the survey due to the higher survey speed. Overall internal accuracy values for the other three data sets were fairly consistent (68-69%). For all the data sets the circalittoral rock (MCR) and circalittoral mud (CMU) life-forms showed the highest internal accuracies. The infralittoral rock life-form (MIR) was regularly confused with the circalittoral rock (MCR) life-form, which is a likely consequence of similar acoustic properties between these two habitats. The remaining life-forms, which are likely to have acoustic signatures somewhere between the extremes of rock and mud and are likely to consist of varying proportions of soft and hard substrates, were regularly confused with each other. On the whole, the internal accuracy measures indicate that the classification process worked reasonably well.

Calanus N-S 4kts SAMS 100m

		Ground-truth data							
		CGS	CGS.B	CMS	CMU	MCR	MIR	Total	% Correct
Mapped units	CGS	48	18	7	5	4	0	82	59
	CGS.B	1	42	0	7	5	0	55	77
	CMS	11	19	67	46	1	0	144	47
	CMU	6	27	1	83	0	0	117	71
	MCR	3	14	0	1	108	0	126	86
	MIR	0	0	0	0	6	13	19	69
	Total	69	120	75	142	124	13	543	
	% Correct	70	35	90	59	87	100		**68%**

Calanus N-S 8kts SAMS 100m

		Ground-truth data							
		CGS	CGS.B	CMS	CMU	MCR	MIR	Total	% Correct
Mapped units	CGS	51	35	14	16	29	0	145	35
	CGS.B	3	26	0	11	11	0	51	51
	CMS	8	36	56	20	5	0	125	45
	CMU	2	6	0	95	2	0	105	91
	MCR	4	17	5	0	68	0	94	72
	MIR	1	0	0	0	9	13	23	57
	Total	69	120	75	142	124	13	543	
	% Correct	74	22	75	67	65	100		**57%**

Seol Mara E-W 6kts SAMS 70m

		Ground-truth data							
		CGS	CGS.B	CMS	CMU	MCR	MIR	Total	% Correct
Mapped units	CGS	35	21	5	20	1	0	82	43
	CGS.B	8	44	0	8	5	0	65	68
	CMS	18	31	66	11	0	0	126	52
	CMU	6	12	4	102	2	0	126	81
	MCR	2	12	0	1	111	0	126	88
	MIR	0	0	0	0	5	13	18	72
	Total	69	120	75	142	124	13	543	
	% Correct	51	37	88	72	90	100		**69%**

Seol Mara E-W 6kts STEN 70m

		Ground-truth data							
		CGS	CGS.B	CMS	CMU	MCR	MIR	Total	% Correct
Mapped units	CGS	26	9	6	5	1	0	47	65
	CGS.B	7	36	1	8	4	0	56	64
	CMS	24	26	57	7	1	0	115	50
	CMU	11	42	11	120	1	0	185	65
	MCR	1	7	0	2	116	0	126	92
	MIR	0	0	0	0	1	13	14	29
	Total	69	120	75	142	124	13	543	
	% Correct	38	30	76	85	35	100		**68%**

Table 2. Internal error matrices for the six life-forms for each of the four RoxAnn maximum likelihood maps.

In a similar way to the internal accuracy assessments, external accuracy assessments were also carried out on the four RoxAnn maps (Table 3). This method provides a more robust means of assessing accuracy. It uses similar comparisons as the internal accuracy assessment test but instead of using the ground-truth data used

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during the maximum likelihood classification process it compares the number of pixels of each life-form from a buffered external ground-truth data set (i.e. the ground-truth tows shown in blue in Figure 8 which were held back for the purpose of validation). As for the internal accuracy matrices the highlighted diagonal cells within each matrix in Table 3 indicate an exact match between ground-truthing and map pixels. Unfortunately the external ground-truthing video tows did not cover any of the infralittoral rock life-form (MIR) and therefore this class had to be removed from the analysis.

Overall accuracies were, not surprisingly, much lower than the internal accuracies. The poorest performance was from the data set collected aboard RV Calanus at 4 knots which showed an overall accuracy of just 20%. The other three maps performed slightly better with overall accuracies between 28-30% (Table 3). The circalittoral rock life-form (MCR) was often mistaken for the circalittoral gravely sand with boulders (CGS.B) life-form which can probably be explained as both these habitats consist of a relatively hard, acoustically reflective substrata which are likely to be confused during the classification process. The circalittoral mud life-form (CMU) was also commonly misclassified. It should be noted that the external ground-truthing data set was fairly modest in terms of coverage, and a fairer estimate of map accuracy would have been achieved if a larger external data set had been used. Nonetheless, the results highlight some of the problems associated with misclassification of similar biotopes.

The sidescan sonar data could only be divided with confidence into three acoustic classes (Figure 7: high reflectivity – classified as MCR/MIR; low reflectivity – classified as CMU; and intermediate backscatter values – left uncoloured in the figure). It is therefore not possible to map beyond the resolution of these three classes using this data, unless other parameters such as depth are also used to help refine the classification. External accuracy assessments on the interpretation of the sidescan sonar data set for the mud (CMU) and rock (MCR/MIR) life form classes revealed an overall accuracy measure of 55% (Table 4). This value is higher than the overall external accuracies for the RoxAnn maximum likelihood maps, but is still relatively low. It should be noted, however, that the sidescan interpretation is based

Calanus N-S 4kts SAMS 100m

Mapped units	Ground-truth data: CGS	CGS.B	CMS	CMU	MCR	Total	% Correct
CGS	1	6	5	0	2	14	8%
CGS.B	0	0	4	0	1	5	0%
CMS	2	2	4	0	0	8	50%
CMU	0	0	0	2	0	2	100%
MCR	3	16	4	0	4	27	15%
Total	6	24	17	2	7	56	
% Correct	17%	0%	24%	100%	68%		**20%**

Calanus N-S 8kts SAMS 100m

Mapped units	Ground-truth data: CGS	CGS.B	CMS	CMU	MCR	Total	% Correct
CGS	2	3	4	0	1	10	20%
CGS.B	0	2	0	1	0	3	67%
CMS	0	3	7	1	2	13	54%
CMU	1	0	1	0	0	2	0%
MCR	4	16	5	0	5	30	17%
Total	7	24	17	2	8	58	
% Correct	29%	8%	41%	0%			**28%**

Seol Mara E-W 6kts SAMS 70m

Mapped units	Ground-truth data: CGS	CGS.B	CMS	CMU	MCR	Total	% Correct
CGS	2	7	6	0	2	17	12%
CGS.B	3	6	4	0	0	13	46%
CMS	0	0	5	2	2	9	66%
CMU	0	0	1	0	0	1	0%
MCR	2	11	1	0	4	18	22%
Total	7	24	17	2	8	58	
% Correct	29%	25%	30%	0%	50%		**30%**

Seol Mara E-W 6kts STEN 70m

Mapped units	Ground-truth data: CGS	CGS.B	CMS	CMU	MCR	Total	% Correct
CGS	0	2	0	0	1	3	0%
CGS.B	0	3	5	0	2	10	30%
CMS	2	3	8	1	1	15	53%
CMU	1	0	0	1	0	2	50%
MCR	4	16	4	0	4	28	15%
Total	7	24	17	2	8	59	
% Correct	0%	13%	47%	50%	50%		**28%**

Table 3. External error matrices for the six life-forms for each of the four RoxAnn maximum likelihood maps.

solely on the backscatter mosaic and that no ground-truthing data was used to assist the interpretation. The production of seabed habitat maps based on sidescan sonar data would normally be produced through an iterative process using both backscatter and ground-truth information. It should also be noted that the mosaic was produced using an average layback value between the sidescan sonar fish and the vessel. This would introduce positional errors which would reduce external accuracy assessment. This could easily be rectified if a higher accuracy map were required by using the exact layback values along each sidescan sonar line, or by attaching a position fixing device to the fish. Nonetheless, this test does highlight the benefits of using swathe

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acoustic systems over single-beam systems, particularly for use in mapping discrete features (i.e. rock reefs) on the seabed.

	CMU	MCR/MIR	Total	% Correct
CMU	26	33	59	44
MCR	7	23	30	77
Total	33	56	89	
% Correct	79	41		**55%**

Table 4. External error matrix for the sidescan sonar interpreted habitat map (Figure 7) of the MCR and CMU life-form classes against all the video ground-truthing data (classification and external ground-truth video data sets).

The maps produced using maximum likelihood classification are predictive maps and a degree of confusion between classes which are likely to have similar acoustic properties should be expected. This raises the question as to whether it is possible to discriminate between the six life-forms acoustically, or whether classes should be merged into broader, acoustically distinctive groups for the purpose of mapping? This issue has been debated at length (Brown et al. 2002; Foster-Smith et al. 2001b; Foster-Smith and Sotheran 2003), and was discussed by the WP during the course of the workshop.

It would have been possible to sub-divide the ground-truthing video data into a larger number of visibly identifiable classes (the six life-forms could have been further divided into more detailed classes (i.e. biotopes) based on the National Marine Habitat Classification for Britain and Ireland Version 03.02, internet version – Connor et al 2003), and many maps produced for SACs attempt to do this. However, it is likely that this would have led to a greater degree of confusion and error between categories on the final habitat map. Within the six life-form classes in the current study there was confusion between a number of classes which probably had similar acoustic properties (e.g. MCR, MIR and CGS.B are all acoustically reflective habitats; CMU and CMS are likely to have similar, relatively low acoustic reflectance). The WP agreed that the process of classifying the ground-truth data was a crucial stage in the production of a seabed map, and it should be strongly noted that not every class identified from video data can be mapped using acoustic techniques. It should also be noted that the maximum likelihood classification technique requires a minimum number of pixels to be covered by training sites for each class in order to develop an adequate set of signatures, therefore if an identified ground-truthing class is too small in extent it cannot be mapped using this procedure.

It is paramount that there is a clear linkage between the classification units and the acoustic technique being used. It is highly likely that a number of visibly identifiable 'units' (whether they be life-forms, biotope complexes or biotopes) recorded using visual survey techniques will fall within a single acoustic map region, and that it will not be possible to map every visibly identifiable 'unit' using acoustic methods. Further research is needed to determine which habitats or communities can be mapped with a high degree of certainty when using an acoustic system (which may be largely hierarchy-independent). An appropriate classification scheme should then be developed for such broadscale mapping that can then be referred to the appropriate units in the National Marine Habitat Classification for Britain and Ireland.

Spatial comparison of habitat maps:

Comparisons were made on the frequency of occurrence of each life-form from each of the RoxAnn maximum likelihood maps, and of the CMU and MCR/MIR life-forms from the sidescan sonar interpretation (Figure 10). The percentage cover of each life-form was generally similar between the four RoxAnn maximum likelihood maps (usually between 5-10% of each other). Noticeable differences were a much lower occurrence of the CGS life-form on the RoxAnn map produced from the data collected aboard RV Seol Mara using the Stenmar-hired RoxAnn system, and the CGS.B life-form from the data set collected aboard RV Calanus running at 8 knots. Comparison of the sidescan sonar and RoxAnn maps revealed that the RoxAnn data sets consistently had lower occurrences of the muddy habitat CMU and higher occurrences of the rocky reef habitats MCR and MIR than interpreted from the sidescan sonar data.

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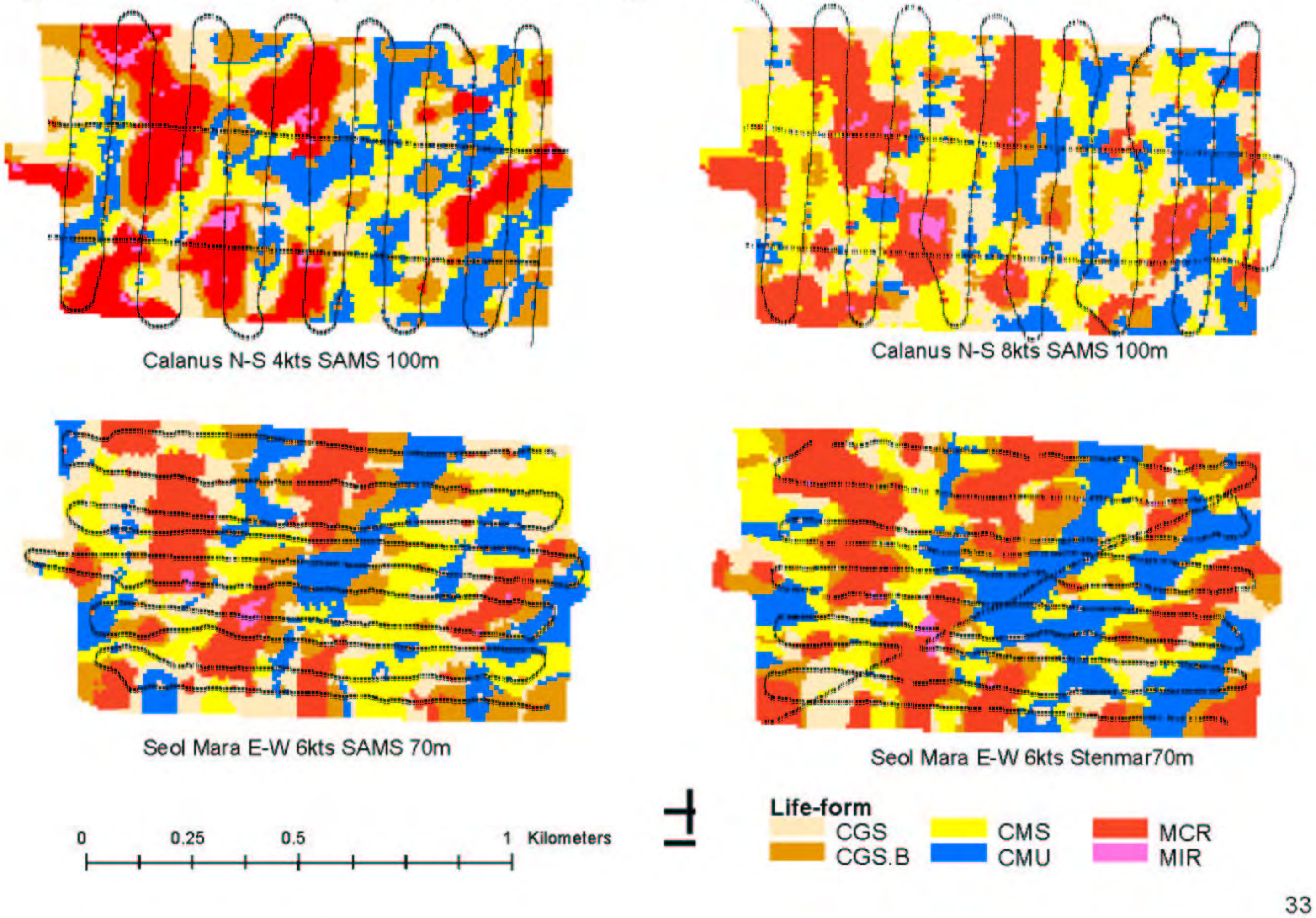
Figure 9. Maximum Likelihood maps from the four RoxAnn surveys. Track plots are overlaid in black.



In addition, the spatial distribution of the six life-forms were compared between each of the RoxAnn maximum likelihood maps. A pixel-by-pixel comparison was conducted using cross-tabulation methods in *Idrisi*. Pair-wise comparisons of each of the maps were performed and then an overall comparison was made between all four maps (Figure 11). Agreement between pair-wise comparisons ranged from 39-43%. A number of regions of rock (MCR) and mud (CMU) appeared to be consistently mapped between surveys. The overall comparison between the four maps revealed 16% agreement. Despite such low values the general pattern of distribution of life-forms was similar, and it should be noted pixel-by-pixel comparisons often hide general spatial trends which can be detected by eye. Additionally, as mentioned in section 3.3, due to the different survey track extents between data sets the edge of the interpolated area was in some instances quite far from any 'real' datapoints, which increases their likelihood of misclassification.

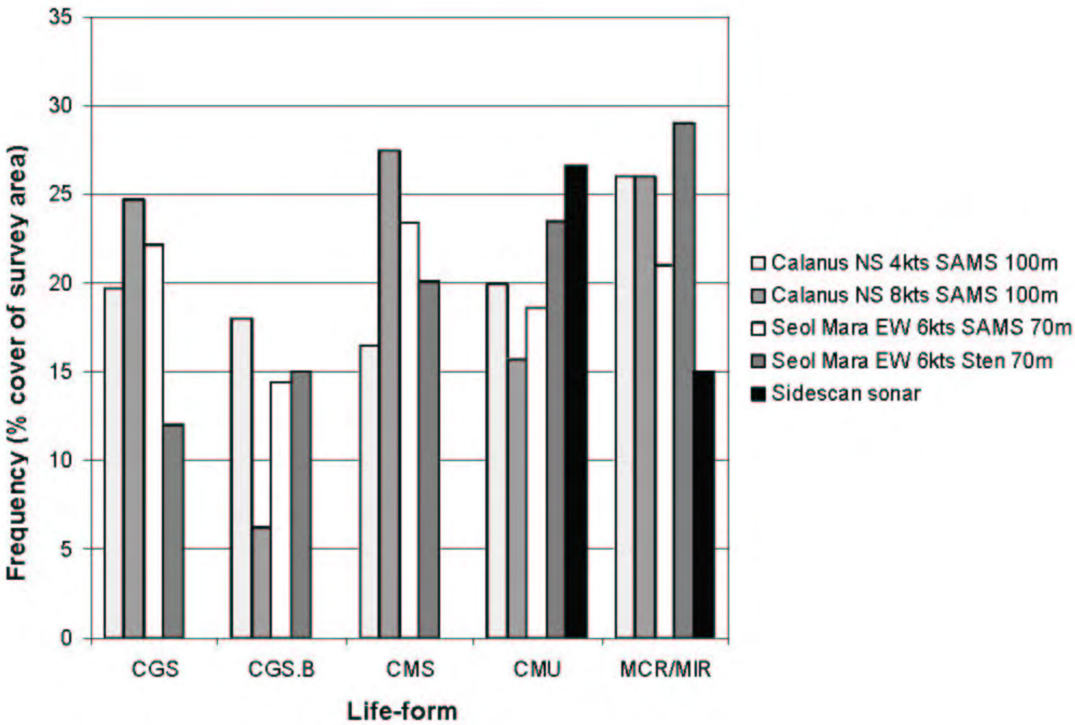


Figure 10. Frequency of each life-form on the four RoxAnn maximum likelihood maps and on the sidescan sonar interpretation.

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A final test was also carried out to compare the mud (CMU) and rocky reef (MCR/MIR) life-forms between the sidescan sonar interpreted map and the four RoxAnn maps. As above, a pixel-by-pixel comparison was conducted using cross-tabulation methods in *Idrisi*, and each of the RoxAnn maps was compared to the sidescan sonar interpretation (Figure 12). White regions represent life-forms other than the CMU or MCR/MIR classes in the case of the RoxAnn maps, or unclassified intermediate backscatter values in the case of the sidescan sonar interpretation. Black areas show regions of disagreement between the sidescan sonar interpretation and each RoxAnn maps for the mud (CMU) and rocky reef (MCR/MIR) life-form areas. Levels of agreement between MCR/MIR and CMU regions on the sidescan sonar map with those same regions on each of the RoxAnn maps ranged from 28-43%. The RoxAnn map produced from the data collected aboard RV Seol Mara using the Stenmar hired RoxAnn system showed the highest agreement with the sidescan sonar interpretation (43%). The RoxAnn maps consistently predicted higher frequency of the MCR/MIR file-forms and lower frequencies of the CMU life form compared to the sidescan sonar map.

Figure 11. Comparison of RoxAnn maximum likelihood maps showing regions classified the same between data sets.

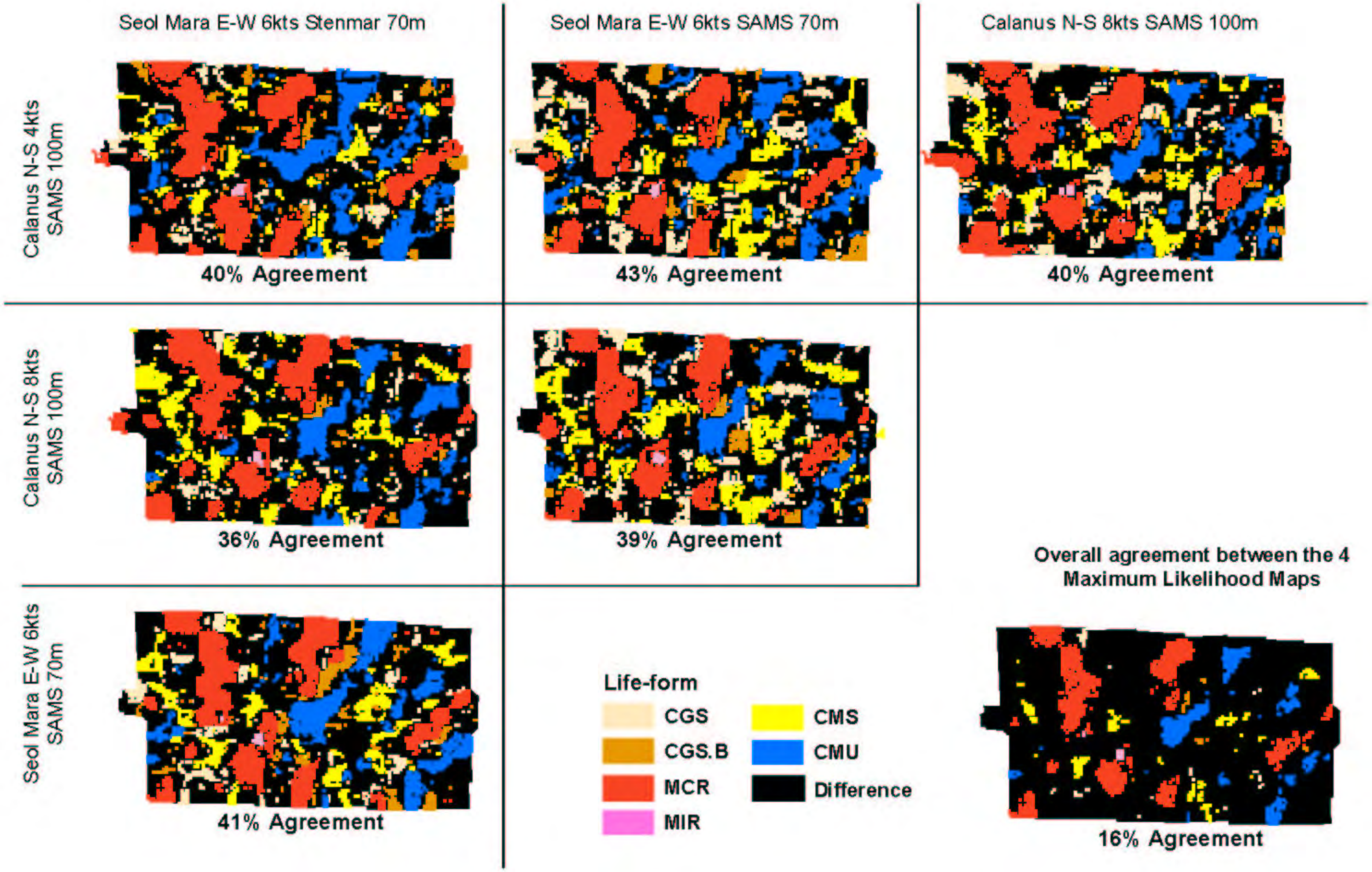
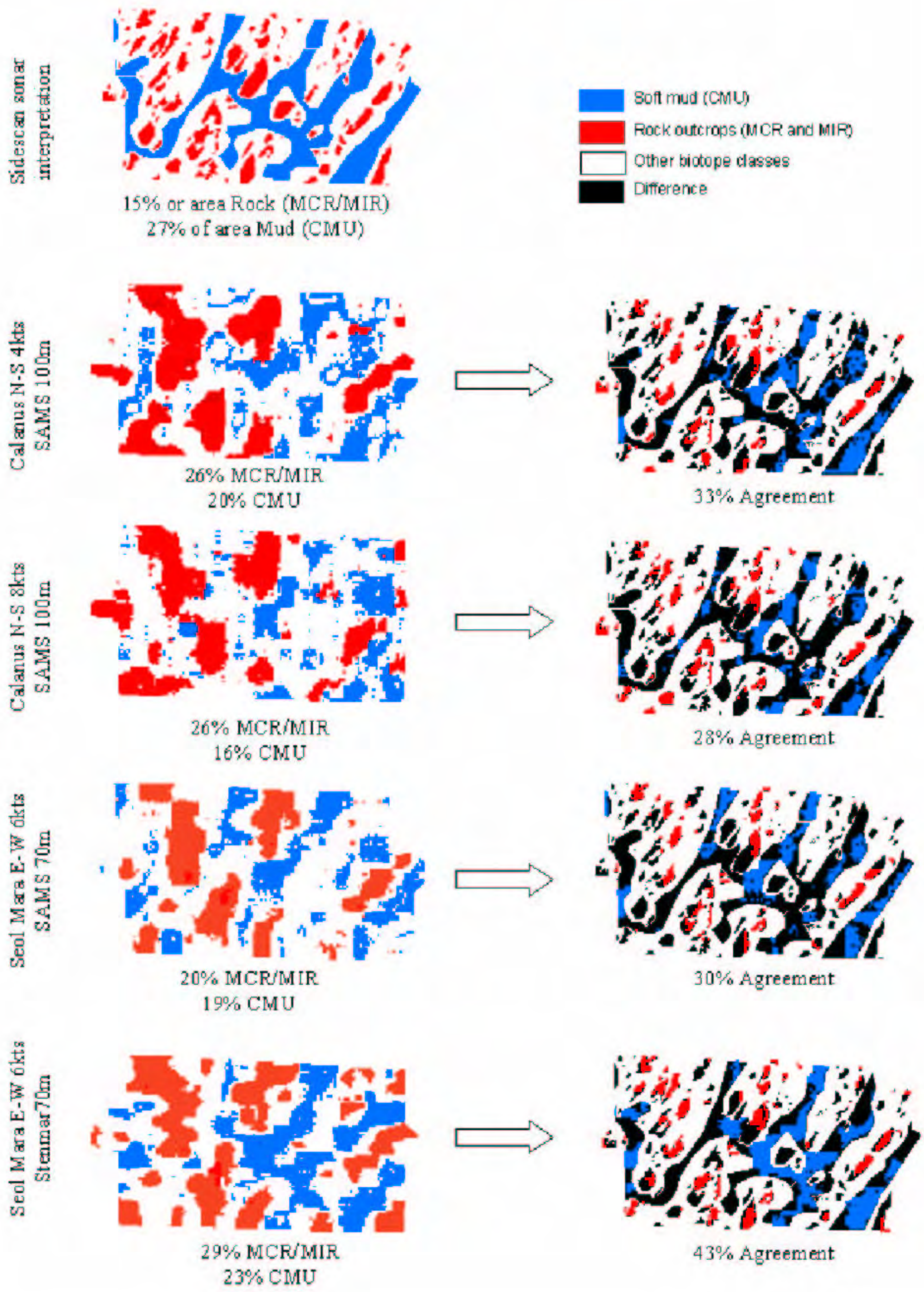


Figure 12. Comparison of RoxAnn maximum likelihood rock (MCR and MIR) and mud (CMU) classes against the sidescan sonar interpretation.



5. Discussion and Conclusions

Surveys of marine areas of conservation or scientific interest using AGDS systems provide a method for broad-scale predictive assessment of seabed characteristics and habitats. The very nature of AGDS systems, using single beam technology, will always mean that interpolation methods will be necessary if continuous coverage maps are required. This will undoubtedly lead to poor discrimination of small-scale features and a degree of miss-classification for the following reasons:

- Values in the un-surveyed regions between survey lines are estimates based on the real data within each survey line. It should be noted that survey track spacing should be adjusted relative to the scale of heterogeneity in the survey area, such that there is less weight upon interpolated data when acoustic signatures are developed.

- There will be a degree of averaging across the echo-sounder footprint, and this itself will lead to poor discrimination where very heterogeneous seabeds are encountered. Additionally, as depth increases so too does the area of the echo-sounder footprint, such that it may span more than one habitat and thus be unable to discriminate between them.

- In regions where there is a large depth range, it is difficult to decide upon the appropriate transducer frequency and beam angle. This can result in problems of depth dependency in the acoustic data which can prove problematic for acoustic signature development where life-forms occur throughout a range of depths.

However, habitat maps produced solely by AGDS provide valuable information relating to broad-scale predictive distributions of habitats and relative abundances of each habitat class within an area. It is crucial that environmental managers using the final habitat maps understand the limitations of the survey techniques, and that they have information relating to how the surveys were conducted (e.g. line-spacing, number of ground-truthing stations etc.) and the processes by which the maps were produced (e.g. interpolation parameters, classification techniques etc.) if the maps are to be used in a responsible and appropriate manner.

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The current study compared four maps produced using data from four separate surveys. Survey parameters varied slightly between each of the data sets (e.g. survey vessel, RoxAnn system, survey speed, survey design). Nonetheless the final habitat maps were all broadly similar. Predicted percentage cover of each of the six life-form classes identified in the survey area showed similar levels of each life-form between the four maps (Figure 10). This measure is useful when assessing how common or rare a particular map unit (i.e. habitat/life-form/biotope) is within a region, and can be a useful measure when making decisions regarding conservation issues relating to particular habitats. Predicted spatial patterns of habitats were broadly similar when comparing each map with each other (approximately 40% agreement), although overall agreement between all four maps was low (16%) (Figure 11). If accurate discrimination of boundaries between habitats is not a crucial requirement of a continuous coverage map then the four maximum likelihood maps produced in this study are probably adequate for management purposes. However, if the end use of the habitat map demands a high degree of accuracy in relation to habitat boundaries and discrete seabed features then AGDS is probably not an appropriate tool for map production and other techniques (i.e. swathe acoustic systems) should be used instead.

Concerns were raised during the open-session of the workshop that the study area was too small and too heterogeneous to make a fair assessment of the ability of AGDS to map seabed habitats. Signature development involves the incorporation of a small buffer around the ground-truth sample positions that are used to extract acoustic data which are assumed to be associated with the habitat class identified from the field record. The resulting acoustic signature may include data that are unlikely to be associated with a particular habitat class and will inevitably lead to signature overlap between habitat classes. This is particularly problematic in regions where the seafloor is very heterogeneous, where different habitat classes lie close together (e.g. either side of a biotope boundary), where large buffers are used, or where ground-truthing samples are not located near any real acoustic data. In the current study buffers were kept as small as possible and ground-truthing samples were targeted on top of AGDS survey lines. Care was also taken when creating the buffers so that as little overlap as possible occurred near the boundaries between life-form classes.

Foster-Smith et al (2000) estimates the footprint size of a standard AGDS system to be in the region of 13 m wide by 20 m long for a vessel working in 10 m of water at a speed of 10 km/h with a dGPS error of 10 m and a beam angle of the AGDS transducer of 15°. All of these survey parameters are similar to those used in the workshop study, and therefore a similar foot print size can be assumed for each of the four RoxAnn surveys, although it should be noted that footprint size will increase as water depths become greater. The distinctive seabed features identified by the sidescan sonar survey (i.e. rocky reefs, regions of soft mud) were usually no less than around 100 m in dimension. Therefore, whilst the seabed within the study area was relatively heterogeneous, the degree of heterogeneity was greater than the foot-print size and equal to or greater than the survey track spacing and was thus within the ability of the AGDS to discriminate. Variogram analysis also indicated that interpolation at this scale, assessed using along track variability which also gives an indication of seabed heterogeneity, was possible as stated in the JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a). Whilst the study site is undoubtedly a challenging area to map, it was felt that the trials were a fair test of the system, and that the area was representative of the high degree of seabed heterogeneity often associated with marine SACs.

Although the aim of the workshop was not to compare the ability of AGDS and sidescan sonar for mapping seabed habitats, comparison of the maps produced using these two systems did prove interesting. The sidescan sonar data was interpreted by eye, and whilst there are developing software packages designed to automate this process, this is by far the most common and accurate method of interpretation at this moment in time. Using this approach three acoustically distinct regions could be confidently identified (Figure 7). In contrast the AGDS data was classified using the video ground-truthing data which was categorised into six life-forms. This ground-truthing data was used to guide the classification process and resulted in the four maximum likelihood maps that contained a degree of disagreement between each other with respect to the spatial distribution of the six life-forms. This raises the question as to the resolution to which benthic habitats can be accurately mapped based on acoustic data.

The decision to use six life-form categories was based on the information derived from the video data. However, whilst six life forms could be distinguished visually this may not have been the case acoustically. In the current study only three acoustically distinct habitats could be mapped when using the sidescan sonar. Within some of these regions there were likely to be several different life-forms (and probably a larger number of biotopes) which could be identified using visual techniques. It is

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important to realise that it not possible to map every visually identifiable class and that continuous coverage maps can only be produced based on the classes, or combination of classes, which can be acoustically distinguished. It would therefore seem better to map at a coarser resolution with a greater degree of spatial accuracy whilst recognising that within each acoustic region there are a number of higher resolution (visually identifiable) classes or ground-types. To monitor and assess abundances and spatial extent of these higher resolution classes' techniques other than acoustics (e.g. video, diver or grab sampling) should be used.

Several advantages of swathe systems compared to AGDS, when continuous coverage maps are required, are clearly demonstrated from the outputs of the workshop. The very nature of AGDS and the many routes through which the data can be processed means that continuous coverage maps produced using different processing methodology and survey approaches will differ slightly from each other. Swathe systems are also not without their limitations and problems. Although not tested during the current workshop, sidescan sonar interpretation of the same area conducted independently by two or more skilled individuals will likely result in slightly different habitat maps as the positioning or habitat boundaries is based on subjective analysis by eye. However, unlike AGDS, carefully designed swathe surveys will give data for every area of the survey site which will remove some of the uncertainty encountered when using AGDS. Features which may be of conservation importance, such as reefs, can easily be missed during the interpolation process when using AGDS if they lie between the tracks. When using swathe acoustic techniques this risk is minimized. The ability of AGDS to discriminate at a higher resolution than swathe systems should not be underestimated though. A number of research and survey teams are now moving towards the complementary use of AGDS and swathe systems when producing continuous coverage maps. With this approach the AGDS data is not interpolated, but instead the track data is classified and overlain on the swathe mosaic to assist interpretation of the backscatter. This is a much more robust approach which utilises the strengths of each system by using the two techniques in a complementary manner.

It should also be acknowledged that maps produced by AGDS are very often subject to more critical appraisal than output generated from more traditional methods such as diver and other spot sampling techniques. Whilst there are limitations and drawbacks to using AGDS for continuous coverage mapping, this approach still offers advantages for this application over the use of conventional methods used alone.

6. Recommendations

- The JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) is, on the whole, comprehensive and sufficiently detailed for the purpose of AGDS surveys in marine SACs or other regions of conservation interest. A degree of flexibility needs to be retained to allow for informed decision making by the surveyor as conditions and requirements are often very different between survey sites.

- The need to ensure high levels of positional accuracy when collecting both AGDS data and ground-truthing data should be strengthened within the JNCC Marine Monitoring Handbook guidelines, particularly when using towed or drop down video systems in relatively deep water.

- Whilst it is not possible to be prescriptive as to the minimum number of ground-truthing data points collected during a survey as this is greatly affected by the degree of homogeneity of the seabed and can vary dramatically from one survey area to the next, it should be highlighted within the JNCC Marine Monitoring Handbook guidelines that increasing the number of ground-truthing stations will strengthen accuracy of the final habitat map and improve the ability to assess the accuracy of such maps.

- AGDS data analysis is a vast subject and many routes can be taken through the process of data interpretation. Different research/survey teams within the UK adopt different approaches and there was insufficient breadth of experience amongst the research teams who participated in the current workshop to compare and contrast a range of approaches. The JNCC Marine Monitoring Handbook (Foster-Smith et al. 2001a) provides a outline to this subject area, and in light of developing methodologies and ideas within this field the guidelines as they stand are sufficiently detailed and allow for a degree of flexibility.

- AGDS systems should not be the only system used when accurate mapping of seabed features is required. Swathe systems are recommended for such applications when a high degree of precision is required for mapping distinct seabed features or boundaries between different acoustically distinct habitats. In such situations AGDS can be used as a complementary system, and can usually be operated along side swathe systems to provide valuable additional data which can often help when interpreting the swathe acoustic data.

- When mapping seabed habitats using acoustic techniques it is crucial that the resolution of the map is linked to what can be discriminated acoustically.

7. Acknowledgements

Thanks are due to the crew of RV Calanus and RV Seol Mara for their help and expertise in collecting the field data, and to Jason Smith, Shona Magill, Craig Sanderson, Alex Keay and Jenny Beaumont for help and support in organising and running the workshop. Appreciation is also expressed to Stenmar Ltd. for sponsorship of the workshop dinner and general support for the workshop. The workshop was jointly funded by the Joint Nature Conservation Committee, Argyll and Isles Enterprise, Scottish Natural Heritage and the National Marine Biological Analytical Quality Control Scheme.

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Annex 15 Report on anthropogenic impacts on UK sand and gravel extraction sites

AN INTEGRATED APPROACH TO THE ASSESSMENT OF ANTHROPOGENIC DISTURBANCE AT MARINE SAND & GRAVEL EXTRACTION SITES

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ABSTRACT

Marine benthic habitats are vulnerable to the influence of a wide range of anthropogenic activities (e.g., sand and gravel extraction, dredged material disposal and trawling). Traditionally, benthic ecologists have relied on point sampling techniques such as grabs, corers and dredges to provide information on the physical nature of the substrates and their associated benthic fauna. However, information of this nature only relates to the specific point on the seabed from which the sample was collected and the interpolation of such data to predict the wider distribution of substrata and associated fauna may be unreliable. Our approach uses a range of acoustic, photographic and physical sampling methodologies to produce continuous acoustic coverage maps which can be used to assist with the interpretation of faunal distributions. This approach has been used to assess the impacts of marine sand and gravel extraction at the seabed at two sites off the east coast of England in the southern North Sea.

The first study site (designated ‘Area 222’) is located 20km off the southeast coast of England and was surveyed in 2001 using sidescan sonar, single beam bathymetry, seabed photography and also a 0.1m^2 Hamon grab for the collection of benthos and sediment samples. The main objectives of this investigation were to provide an indication of the spatial distribution of the sediments and macrofauna in the wider area encompassing the dredged site, to evaluate the scope for the effects of marine sand and gravel extraction to extend beyond the boundaries of the site and to provide a wider geographical context for time series investigations. At this site, an acoustic basemap was utilised in conjunction with faunal sampling and photographic groundtruthing, to determine the nature and distribution of the seabed sediments and their associated features. Disturbances at the seabed arising from historic sand and gravel extraction activities were mapped, and this information was helpful in establishing biological cause and effect relationships. The acoustic basemap was also used to target biological reference sites against which the effects of adjacent man-made disturbances could be evaluated.

As part of a separate study, sidescan sonar surveys were carried out between 1995 and 2003 at a current sand and gravel extraction site (Area 107) located in the southern North Sea, United Kingdom. A characteristic pair of dredge tracks was first identified in 1995 and the persistence of these tracks was monitored using sidescan sonar. Although the sonographs suggest that there has been some evidence of the erosion of the tracks over time, they are still visible eight years after their formation. This is consistent with findings from studies at other extraction sites where the complete erosion of dredge tracks has been observed to take between three and seven years.

This presentation will demonstrate how an integrated sampling approach has been used to contribute towards a better understanding of biological cause and effect relationships at sand and gravel extraction sites.

Annex 16 Proposed amendments to the EUNIS classification of marine habitats (levels 2–4 only)

For further details of EUNIS habitat types, refer to http://eunis.eea.eu.int/eunis/habitats.jsp
For further details of UK habitat types, refer to www.jncc.gov.uk/MarineHabitatClassification
Key to countries for habitat distribution: F = France, I = Iceland, SE = Sweden, IE = Ireland, NL = Netherlands, NO = Norway, PT = Portugal, BE = Belgium, UK = United Kingdom.
The final two columns indicate the relationship of the EUNIS types to the ten OSPAR priority habitats and the proposed four additional priority habitats.
Note: types for the Baltic and Mediterranean have not been changed; in some cases there remains duplication with habitats listed for the north-east Atlantic

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Littoral rock (and other hard substrata)	**A1**	**LR**	No change	F, NL, NO, PT, SE, B, UK		
High energy littoral rock	**A1.1**	**HLR**	Name change from "Littoral rock very exposed to wave action"	B, PT, NL, UK, F		
Mussel and/or barnacle communities	A1.11 & A1.21	MusB	Merge A1.11 "Mussels and/or barnacles on very exposed littoral rock" and A1.21 "Mussels and/or barnacles on littoral rock moderately exposed to wave action".	B, PT, UK, F		
Robust fucoid and/or red seaweed communities	A1.12 & A1.23	FR	Merge A1.12 "Robust fucoids or red seaweeds on very exposed littoral rock" and A1.23 "Red seaweeds on moderately exposed littoral rock".	UK, PT	Occurs within	Littoral chalk communities
Fucoids in tide-swept conditions	A1.31 in part	FT	Proposed separation of tide-swept biotopes of A1.31 "Dense fucoids on sheltered littoral rock" into new level 4 type.	UK		
Communities of the upper mediolittoral rock	A1.13		No change	Mediterranean		
Communities of the lower mediolittoral rock very exposed to wave action	A1.14		No change	Mediterranean		
Moderate energy littoral rock	**A1.2**	**MLR**	Name change from "Littoral rock moderately exposed to wave action".	F, NL, NO, SE, UK, B		
	A1.21		Move to A1.1 and merge with A1.11			
Mussels and fucoids on moderate energy shores	A1.25	MusF	Name change from "Mussels and fucoids on moderately exposed littoral rock"	NL, UK		
Barnacles and fucoids on moderate energy shores	A1.22	BF	Name change from "Fucoids and barnacles on moderately exposed littoral rock"	NL, F, NO, UK, SE, B	Occurs within	Littoral chalk communities
	A1.23		Move to A1.1 and merge with A1.12			
Littoral Sabellaria honeycomb worm reefs	A1.26	Sab	Name change from "[Sabellaria] reefs on littoral rock"	F, UK		

Habitat name (proposed or existing)	**EUNIS code**	**UK code**	**Action proposed**	**Countries in which found (from data supplied)**	**Relation-ship to OSPAR priority habitat**	**OSPAR priority habitat**
Communities of the lower mediolittoral rock moderately exposed to wave action	A1.27		No change	Mediterranean		
Low energy littoral rock	**A1.3**	**LLR**	Name change from "Littoral rock sheltered from wave action".	F, NO, PT, NL, UK		
Fucoids on sheltered marine shores	A1.31 in part & A1.32 in part	F	Merge marine biotopes of A1.31 "Dense fucoids on sheltered littoral rock" and A1.32 "Fucoids, barnacles or ephemeral seaweeds on sheltered littoral mixed substrata". Biotopes in tide-swept conditions moved to new level 4 habitat (FT) in A1.1	NO, PT, NL, UK		
Fucoids in variable salinity	A1.31 in part & A1.32 in part	FVS	Separate variable salinity biotopes within A1.31 "Dense fucoids on sheltered littoral rock" and A1.32 "Fucoids, barnacles or ephemeral seaweeds on sheltered littoral mixed substrata" as new level 4 type.	NO, UK		
	A1.33		Move A1.33 "Mussel beds on sheltered littoral mixed substrata" to A2 as a new level 4 biotope complex.			
Red algal turf in lower eulittoral, sheltered from wave action	A1.34		More evidence required	North-east Atlantic		
Communities of the lower mediolittoral rock sheltered from wave action	A1.35		No change	Mediterranean		
Rock habitats exposed by action of wind (e.g., hydrolittoral)	**A1.4**		No change	Baltic		
Hydrolittoral soft rock	A1.41		No change	Baltic		
Hydrolittoral solid rock (bedrock)	A1.42		No change	Baltic		
Hydrolittoral hard clay	A1.43		No change	Baltic		
Hydrolittoral [Mytilus edulis] beds	A1.44		No change	Baltic		
Hydrolittoral peat	A1.45		No change	Baltic		
Features of littoral rock	**-**	**FLR**	Proposed new level 3 habitat	F, NL, NO, PT, SE, UK		
Rockpools	A1.5	Rkp	Relegation of A1.5 to level 4 within a new level 3 habitat	NO, PT, UK, F		
Littoral caves and overhangs	A1.6	CvOv	Relegation of A1.6 to level 4 within a new level 3 habitat	SE, UK	Occurs within	Littoral chalk communities

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Ephemeral green or red seaweeds (freshwater or sand-influenced)	A1.24	Eph	Name change from "Ephemeral green or red seaweeds (freshwater- or sand-influenced) on moderately exposed littoral rock" and moved from A1.2.	NL, UK, B		
Littoral sediment	**A2**	**LS**	No change	F, I, UK, PT, NL, B, NO, SE		
Littoral coarse sediment	**A2.1**	**LCS**	Name change from "Littoral gravels and coarse sands"	F, I, UK		
Shingle (pebble) and gravel shores	A2.11 & A2.12	Sh	Proposed merging of A2.11 "Shingle and gravel shores" and A2.12 "Estuarine coarse sediment shores".	F, I, UK		
Communities of the mediolittoral coarse detritic bottoms	A2.13		No change	Mediterranean		
Littoral sand and muddy sand	**A2.2**	**LSa**	No change	F, NL, PT, UK, I, B		
Strandline	A2.241	St	New level 4 biotope complex to include A2.241 "Talitrid amphipods in decomposing seaweed on the strand-line". Note: habitat occurs on many shores regardless of substratum type.	F, UK		
	A2.21		Proposed removal of A2.21 "Sandy and muddy sand shores with 90-100% air exposure". Section revised to reflect sediment stability based on biological character.			
	A2.22		Proposed removal of A2.22 "Sandy and muddy sand shores with 70-90% air exposure". Section revised to reflect sediment stability based on biological character.			
	A2.23		Proposed removal of A2.23 "Sandy and muddy sand shores with <70% air exposure". Section revised to reflect sediment stability based on biological character.			
Barren or amphipod-dominated mobile sand shores	A2.24 in part	MoSa	Separation of A2.24 "Sand shores" into 3 new level 4 biotope complexes, this one to include A2.242 "Barren coarse sand shores" and A2.243 "Burrowing amphipods and [Eurydice pulchra] in well-drained clean sand shores".	F, NL, B, I, UK		
Polychaete/amphipod-dominated fine sand shores	A2.24 in part	FiSa	Separation of A2.24 "Sand shores" into 3 new level 4 biotope complexes, this one to include A2.244 "Burrowing amphipods and polychaetes in clean sand shores"	B, NL, NO, UK		
Polychaete/bivalve-dominated muddy sand shores	A2.25	MuSa	Name change from "Muddy sand shores"	NL, UK		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Biocenosis of the mediolittoral sands	A2.26		No change	Mediterranean		
Littoral mud	**A2.3**	**LMu**	No change	F, NL, B, I, NO, UK	Equals	Intertidal mudflats (with two sub-types: marine and estuarine)
	A2.31		Propsed removal of A2.31 "Muddy shores with 90-100% air exposure". Section revised to reflect salinity regime based on biological character.			
	A2.32		Propsed removal of A2.32 "Muddy shores with 70-90% air exposure". Section revised to reflect salinity regime based on biological character.			
	A2.33		Propsed removal of A2.33 "Muddy shores with <70% air exposure". Section revised to reflect salinity regime based on biological character.			
Marine mud shores	-		Proposed new level 4 habitat to account for habitats in the Waddensea and elsewhere	North-east Atlantic		
Polychaete/bivalve-dominated mid estuarine mud shores	A2.36 in part & A2.37 in part	MEst	Name change from A2.36 "Sandy mud shores", to include some biotopes from A2.37 "Soft mud shores".	F, NL, UK		
Polychaete/oligochaete-dominated upper estuarine mud shores	A2.37 in part	UEst	Name change from A2.37 "Soft mud shores".	NL, PT, UK		
	A2.34		Proposed removal of A2.34 "Saltmarsh creeks" as mud communities the same as those in A2.37 (UEst).	North-east Atlantic		
Saltmarsh pools	A2.35		To be validated. Consider treating at level 5 within A2.37 (UEst).	North-east Atlantic		
Littoral mixed sediment	**A2.4**	**LMX**	Name change from "Littoral combination sediments"	UK		
Gravely sandy mud shores	A2.41 in part	GvMu	Separation of A2.41 "Sheltered combination sediment shores" into 2 new level 4 biotope complexes	UK		
Species-rich mixed sediment shores	A2.41 in part	Mx	Separation of A2.41 "Sheltered combination sediment shores" into 2 new level 4 biotope complexes	UK		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Habitats with sediments exposed by action of wind (e.g., hydrolittoral)	**A2.5**		No change	Baltic		
Hydrolittoral stony substrates	A2.51		No change	Baltic		
Hydrolittoral gravel substrates	A2.52		No change	Baltic		
Hydrolittoral sandy substrates	A2.53		No change	Baltic		
Hydrolittoral muddy substrates	A2.54		No change	Baltic		
Hydrolittoral mixed sediment substrates	A2.55		No change	Baltic		
Geolittoral wetlands and meadows: reed, rush and sedge stands	A2.56		No change	Baltic		
Littoral macrophyte-dominated sediment	**A2.7**	**LMP**	Name change from "Littoral sediments dominated by aquatic angiosperms".	UK, SE, PT		
Saltmarsh	A2.6	Sm	Relegation of A2.6 "Coastal saltmarshes and saline reedbeds" to level 4 to occur within A2.7	PT, SE, UK		
Seagrass beds on sediment shores	A2.71 & A2.73	LSgr	Combine A2.71 "[Zostera] beds on littoral sediments" and A2.73 "[Ruppia] beds on littoral sediments" under a generic seagrass beds habitat	UK	Includes	*Zostera beds (includes two sub-types: Zostera noltii beds and Zostera marina beds)*
[Eleocharis] beds	A2.72		No change	Mediterranean		
Littoral biogenic reefs	**A2.8**	**LBR**	Name change from "Biogenic structures on littoral sediments"	NL, UK, SE		
	A2.81		Propose removal of A2.81 "Biogenic features (scars) on littoral mixed sediments" (redundant category).			
Mussel beds on sediment shores	A1.33	LMus	Move A1.33 "Mussel beds on sheltered littoral mixed substrata" to A2.8 as a new level 4 biotope complex.	NL, UK, SE	Equals	*Mytilus edulis beds on sediment shores*

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Features of littoral sediment	-		Proposed new level 3.			
Methane seeps in littoral sediments	A2.74		Move from A2.7 to new level 3 (features of littoral sediment)	North-east Atlantic		
Infralittoral rock (and other hard substrata)	**A3 in part**	**IR**	Propose separate A3 "Sublittoral rock and other hard substrata" into two separate level 3 habitats based on depth/light (infralittoral and circalittoral).	NL, NO, PT, UK, F		
High energy infralittoral rock	**A3.1**	**HIR**	Name change from "Infralittoral rock very exposed to wave action and/or currents and tidal streams"	NO, F, PT, UK		
Kelp with cushion fauna, foliose red seaweeds or coralline crusts (high energy infralittoral rock)	A3.11	KFaR	No change	F, PT, NO, UK		
Sand or gravel-affected or disturbed kelp and seaweed communities	A3.23	KSed	A3.23 "Sand-tolerant or disturbed kelp and seaweed on moderately exposed infralittoral rock" moved to A3.1 with name change.	PT, UK, F		
Frondose algal communities (other than kelp)	A3.15		Name change from "Areas dominated by frondose algae, other than kelp"	North-east Atlantic		
Encrusting algal communities	A3.14		Name change from "Areas dominated by encrusting algae)	North-east Atlantic		
Fauna and seaweeds on vertical high energy infralittoral rock	A3.12		No change	UK		
Communities of infralittoral algae very exposed to wave action	A3.13		No change	Mediterranean		
Moderate energy infralittoral rock	**A3.2**	**MIR**	Name change from "Infralittoral rock moderately exposed to wave action and/or currents and tidal streams"	NO, F, UK		
Kelp with red seaweeds (moderate energy infralittoral rock)	A3.21 & A3.22	KR	Proposed merging of A3.21 "Kelp and red seaweeds on moderately exposed infralittoral rock" and A3.22 "Grazed kelp with algal crusts on moderately exposed infralittoral rock" into a single level 4 biotope complex.	NO, UK, F		
Tide-swept kelp and seaweeds (sheltered infralittoral rock)	-	KT	New level 4 biotope complex to include level 5 tide-swept kelp and seaweed communities in estuaries and sealoch narrows.	UK, F		
Faunal communities on moderate energy infralittoral rock	A3.27		Name change from "Animal-dominated communities of moderately exposed infralittoral rock"	North-east Atlantic		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Fauna and seaweeds on vertical moderate energy infralittoral rock	A3.24		No change	UK		
Baltic brackish water sublittoral biocenoses of hard substrata influenced by varying salinity	A3.26		No change	Baltic		
Communities of infralittoral algae moderately exposed to wave action	A3.25		No change	Mediterranean		
Low energy infralittoral rock	**A3.3**	**LIR**	Name change from "Infralittoral rock sheltered from wave action and currents and tidal streams"	NL, F, NO, PT, UK		
Silted kelp (low energy infralittoral rock)	A3.31	K	Estuarine biotopes within A3.31 moved to new level 4 type (KVS).	NO, PT, UK, F		
Kelp in variable salinity	A3.31 in part	KVS	Removal from A3.31 of those level 5 biotopes with variable salinity into a distinct level 4 biotope complex.	NO, UK		
Faunal communities on low energy infralittoral rock	A3.35		Name change from A3.35 "Animal-dominated communities of sheltered infralittoral rock in full salinity".	North-east Atlantic		
Faunal communities on low energy infralittoral rock in variable salinity	A3.32	IFaVS	Name change from "Estuarine faunal communities on shallow rock or mixed substrata"	UK		
Submerged fucoids, green or red seaweeds on reduced salinity infralittoral rock	A3.33	Lag	Name change from "Submerged fucoids, green and red seaweeds on reduced/low salinity infralittoral rock"	NL, UK		
Communities of infralittoral algae sheltered from wave action	A3.34		No change	Mediterranean		
Features of infralittoral rock	**A3.4 & other habitats**	**FIR**	Proposed new level 3 habitat to include A3.4 "Caves, overhangs and surge gullies in the infralittoral zone"	F, NL, UK		
Robust faunal cushions and crusts (surge gullies and caves)	A3.41	SG	No change	F, UK		
Infralittoral fouling communities	-	IFou	Proposed new level 4 biotope complex	NL, UK		
Vents and seeps in infralittoral rock	-		Proposed new level 4 habitat to reflect shallower algal covered examples of A3.C			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Circalittoral rock (and other hard substrata)	**A3 in part**	**CR**	Proposed new level 2 habitat complex	NO, PT, UK		
High energy circalittoral rock	**A3.5**	**HCR**	Name change from "Circalittoral rock very exposed to wave action or currents and tidal streams"	UK		
Very tide-swept faunal communities	A3.53 in part	FaT	Renaming of A3.53 "Barnacle, cushion sponge and [Tubularia] communities on very tide-swept circalittoral rock" to include other very tide-swept communities. Estuarine types moved to A3.6 (CFaVS).	UK		
Deep sponge communities (circalittoral)	A3.8 & A3.61 in part	DpSp	Separation of A3.61 "Mixed faunal turf communities on moderately exposed circalittoral rock" into two level 4 biotope complexes. This one to include deep sponge communities on very exposed coasts (=A3.8).	UK, IE		
Mixed faunal turf communities	A3.51, A3.52 in part, A3.61, A3.62 in part, A3.67	XFa	Proposed merging of A3.51 "Faunal crusts or short turfs on exposed circalittoral rock", parts of A3.52 "[Alcyonium]-dominated communities on tide-swept circalittoral rock", those parts of A3.61 "Mixed faunal turf communities on moderately exposed circalittoral rock" not included in previous biotope (DpSp), parts of A3.62 "Sand-influenced bryozoan and hydroid turfs on moderately exposed circalittoral rock" and A3.67 "Silt-influenced ascidian communities on moderately exposed circalittoral rock" into a single level 4 biotope complex. Based on reanalysis of biotope data to bring range of turf communities into single biotope complex.	UK		
Moderate energy circalittoral rock	**A3.6**	**MCR**	Name change from "Circalittoral rock moderately exposed to wave action or currents and tidal streams"	PT, UK		
Echinoderms and crustose communities	A3.52 in part, A3.62 in part, A3.65 & A3.66	EcCr	Proposed merging of some biotopes in A3.52 "[Alcyonium]-dominated communities on tide-swept circalittoral rock", remaining parts of A3.62 "Sand-influenced bryozoan and hydroid turfs on moderately exposed circalittoral rock", A3.65 "Brittlestar beds on circalittoral rock or mixed substrata" and A3.66 "Grazed faunal communities on moderately exposed or sheltered circalittoral rock" into a single level 4 biotope complex. Based on reanalysis of biotope data to being together grazed and crustose-dominated communities.	UK		
Circalittoral Sabellaria reefs (on rock)	A3.63	CSab	Name change from "[Sabellaria spinulosa] communities on circalittoral rock"	UK	Occurs within	*Sabellaria spinulosa reefs*

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Soft rock communities	A3.68	SfR	Name change from "Communities on soft moderately exposed circalittoral rock"	UK		
Circalittoral mussel beds (on rock)	A3.64	CMus	Name change from "Mussel beds on moderately exposed circalittoral rock"	F, UK		
Circalittoral faunal communities in variable salinity	A3.53 in part	CFaVS	Separation of A3.53 "Barnacle, cushion sponge and [Tubularia] communities on very tide-swept circalittoral rock" into full and variable salinity level 4 biotope complexes.	UK		
Faunal communities on vertical circalittoral rock	A3.69		No change	UK		
Coralligenous communities moderately exposed to hydrodynamic action	A3.6A		No change	Mediterranean		
Faunal communities on deep moderate energy circalittoral rock	A3.9 & A3.91		Propose moving A3.9 "Deep circalittoral rock habitats exposed to moderately strong currents" to A3.6 and relegating to level 4 biotope complex. A3.91 becomes redundant.	Baltic		
Low energy circalittoral rock	**A3.7**	**LCR**	Name change from "Circalittoral rock sheltered from wave action and currents including tidal streams"	NO, UK		
Brachiopod and ascidian communities	A3.71	BrAs	Name change from "Brachiopods and solitary ascidian communities on sheltered circalittoral rock"	UK		
	A3.72		A3.72 "Sheltered [Modiolus] beds" moved to A4.64.			
Coralligenous communities sheltered from hydrodynamic action	A3.73		No change	Mediterranean		
Faunal communities on deep low energy circalittoral rock	A3.A & A3.A1		Relegate 3.A "Deep circalittoral rock habitats exposed to weak or no currents" to level 4 biotope complex withinin A3.7. A3.A1 becomes redundant. Remains to be validated, but likely to occur in Scandinavian fjords.	?NO		
Features of circalittoral rock	**-**	**FCR**	Proposed new level 3 habitat	UK		
Caves and overhangs (circalittoral)	A3.B & A3B1 & A3B2	Cv	Relegate A3.B "Caves and overhangs below the infralittoral zone" to level 4 within new level 3 habitat FCR. A3B1 & A3B2 become redundant.	UK		
Circalittoral fouling communities	-	FouFa	Proposed new level 4 biotope complex	UK		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Vents and seeps in circalittoral rock	A3.C		Relegate A3.C to level 4 withinin new level 3 habitat FCR and change name from "Vents and seeps in sublittoral rock" (create equivalent habitat in infralittoral zone).	Baltic, north-east Atlantic		
Sublittoral sediment	**A4**	**SS**	No change	F, I, SE, IE, NL, NO, PT, BE, UK		
Sublittoral coarse sediment	**A4.1**	**SCS**	Name change from "Sublittoral mobile cobbles, gravels and coarse sands"	F, I, SE, IE, NL, NO, PT, BE, UK		
Sublittoral coarse sediment in variable salinity	A4.15	EstCS	Name change from "Animal communities in variable or reduced salinity gravels and coarse sands"	I, NO, PT, UK		
Infralittoral coarse sediment	A4.11 & 4.12	ICS	Proposed merging of A4.11 "Animal communities in shallow-water gravels" and A4.12 "Animal communities in shallow-water coarse sands"	B, IE, NL, NO, PT, SE, I, UK, F		
Circalittoral coarse sediment	A4.13	CCS	Name change from "Animal communities of circalittoral mobile cobbles, gravels and sands"	F, NL, I, NO, PT, UK		
Offshore circalittoral coarse sediment	A4.14, A4.71 & A4.73	OCS	Proposed merging of A4.71 "Animal communities of deep circalittoral gravel bottoms" and A4.73 "Animal communities of deep circalittoral shell gravel bottoms" and elimination of A4.14 "Animals communities in deeper coarse sands".	NO, UK		
Sublittoral sand	**A4.2**	**SSa**	Name change from "Sublittoral sands and muddy sands"	NL, PT, NO, I, BE, SE, UK		
Sublittoral sand in reduced salinity	A4.24 in part & A.4.26 in part	LagSa	Proposed merging of A4.24 "Animal communities in variable or reduced salinity shallow clean sands" and A4.26 "Animal communities in variable or reduced salinity muddy sands". Separation of lagoonal and estuarine sand habitats.	NL, UK, F		
Sublittoral sand in variable salinity	A4.24 in part & A.4.26 in part	EstSa	Proposed merging of A4.24 "Animal communities in variable or reduced salinity shallow clean sands" and A4.26 "Animal communities in variable or reduced salinity muddy sands". Separation of lagoonal and estuarine sand habitats.	I, NE, UK, F		
Infralittoral fine sand	A4.21, A4.22, & A4.23	IFiSa	Proposed merging of A4.21 "Animal communities in fully marine shallow clean sands", A4.22 "Communities of fine sands in very shallow waters", and A4.23 "Communities of well sorted fine sands".	F, B, I, NL, PT, SE, NO, UK		
Infralittoral muddy sand	A4.25	IMuSa	Name change from "Animal communities in fully marine shallow-water muddy sands"	F, B, NL, PT, UK		

Habitat name (proposed or existing)	**EUNIS code**	**UK code**	**Action proposed**	**Countries in which found (from data supplied)**	**Relation-ship to OSPAR priority habitat**	**OSPAR priority habitat**
Circalittoral fine sand	-	CFiSa	Proposed new level 4 habitat	NL, SE, I, PT, UK		
Circalittoral muddy sand	A4.27	CMuSa	Name change from "Animal communities of circalittoral muddy sands"	F, NL, NO, UK		
Offshore circalittoral sand	A4.72	OSa	Name change from "Animal communities of deep circalittoral sandy bottoms"	NO, UK		
Communities of the muddy detritic bottom	A4.28		No change	Mediterranean		
Sublittoral mud	**A4.3**	**SMu**	No change	F, B, I, NL, NO, PT, SE, UK		
Sublittoral mud in reduced salinity	A4.32 in part	LagMu	Proposed separation of A4.32 "Variable or reduced salinity sublittoral muds" into separate lagoonal and estuarine habitats	NL, UK, F		
Sublittoral mud in variable salinity	A4.32 in part	EstMu	Proposed separation of A4.32 "Variable or reduced salinity sublittoral muds" into separate lagoonal and estuarine habitats	I, NL, PT, SE, UK		
Infralittoral sandy mud	A4.31 in part	ISaMu	Proposed separation of A4.31 "Shallow fully marine mud communities" into separate "sandy mud" and "fine mud" habitats	B, I, NL, NO, UK, SE, F		
Infralittoral fine mud	A4.31 in part	IFiMu	Proposed separation of A4.31 "Shallow fully marine mud communities" into separate "sandy mud" and "fine mud" habitats	I, NL, NO, UK, F		
Circalittoral sandy mud	A4.36 in part	CSaMu	Proposed separation of A4.36 "Animal communities of circalittoral muds" into separate "sandy mud" and "fine mud" habitats	I, NL, NO, SE, UK		
Circalittoral fine mud	A4.36 in part	CFiMu	Proposed separation of A4.36 "Animal communities of circalittoral muds" into separate "sandy mud" and "fine mud" habitats	I, NO, SE, UK	Includes	Seapens and burrowing megafauna communities
Offshore circalittoral mud	A4.74	OMu	Name change from "Animal communities of deep circalittoral muddy bottoms"	NO, SE, I		
Communities of superficial muddy sands in sheltered waters	A4.33		No change	Mediterranean		
Communities of coastal terrigenous muds	A4.34		No change	Mediterranean		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
	A4.35		Move A4.35 "Periodically and permanently anoxic sublittoral muds" to new level 3 habitat (organically-enriched and anoxic habitats).	North-east Atlantic		
Sublittoral mixed sediment	**A4.4**	**SMx**	Name change from "Sublittoral combination sediments"	F, I, IE, NO, UK		
	A4.41		Move A4.41 to A4.5			
Sublittoral mixed sediment in reduced salinity	A4.43 in part	LagMx	Proposed separation of A4.43 "Variable and reduced salinity sublittoral mixed sediments" into separate lagoonal and estuarine habitats	F, UK		
Sublittoral mixed sediment in variable salinity	A4.43 in part	EstMx	Proposed separation of A4.43 "Variable and reduced salinity sublittoral mixed sediments" into separate lagoonal and estuarine habitats	UK		
Infralittoral mixed sediment	A4.42	IMx	Name change from "Animal communities in shallow-water mixed sediments"	F, I, NO, UK	Includes	*Ostrea edulis beds*
Circalittoral mixed sediment	A4.44	CMx	Name change from "Animal communities of circalittoral mixed sediments"	NO, UK		
Offshore mixed sediment	A4.75	OMx	Name change from "Animal communities of deep circalittoral mixed sediment bottoms"	I, NO, UK		
Communities of the coastal detritic bottom	A4.45		No change	Mediterranean		
Communities of shelf-edge detritic bottom	A4.76		No change	Mediterranean		
Sublittoral macrophyte-dominated sediment	**A4.5**	**SMp**	Name change from "Shallow sublittoral sediments dominated by angiosperms"	F, UK, NO, PT, SE		
Maerl beds	A4.61, A4.62 & A4.65	Mrl	Proposed merging of A4.61 "Seaweeds and maerl on coarse shallow-water sediments", A4.62 "Maerl beds on shallow-water muddy mixed sediments" and A4.65 "Maerl beds on deep-water muddy sediments" into a single level 4 biotope complex	F, UK	Equals	Maerl beds
Kelp and seaweed communities on sublittoral sediment	A4.41	KSwSS	Name change from "Kelp and seaweeds on shallow-water mixed sediments" to include all sediment types. Move from a4.4 to new level 3 habitat (SMp)	NO, PT, UK		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Sublittoral (or lower shore) seagrass beds	A4.51, A4.52, A4.53, A4.54 & A4.56	SSgr	Proposed relegation of A4.51 "[Cymodocea] beds", A4.52 "[Halophila] beds", A4.53 "[Zostera] beds in infralittoral sediments", A4.54 "[Ruppia] and [Zannichellia] communities" and A4.56 "[Posidonia] beds" to level 5, within a single Seagrass bed level 4 biotope complex.	PT, UK, F	Includes	*Zostera beds (includes two sub-types: Zostera noltii beds and Zostera marina beds)*
Angiosperm communities in reduced salinity	A4.55	Ang	Change name from "Sublittoral macrophyte beds of coastal brackish waters" to include only angiosperms	NO, PT, SE, UK		
Sublittoral biogenic reefs	**A4.6**	**SBR**	Name change from "Biogenic structures over sublittoral sediments"	F, I, IE, NL, NO, PT, SE, UK		
	A4.61		Move to A4.5			
	A4.62		Move to A4.5			
	A4.63		Proposed relegation of A4.63 "Oyster beds" to level 5 within A4.42			
Sublittoral polychaete reefs (on sediment)	-	PoR	Proposed new level 4 biotope complex to include A4.652 "Serpulid reefs on very sheltered circalittoral mixed substrata" and A4.441 "[Sabellaria spinulosa] and [Polydora] spp. on stable circalittoral mixed sediment"	IE, UK	Includes	*Sabellaria spinulosa reefs*
Sublittoral mussel beds (on sediment)	A4.64	Smus	Name chasnge from "Structures formed by mussels over sublittoral sediment". To include A4.432 "[Mytilus edulis] beds in variable salinity shallow-water mixed sediment" and A4.442 "[Modiolus modiolus] beds on circalittoral mixed sediment"	I, NO, NL, UK, PT	Includes	*Modiolus beds*
	A4.65		Move to A4.5			
Coral reefs (circalittoral)	-	Crl	Proposed new level 4 biotope complex to cover Norwegian and Swedish reefs in relatively shallow (circalittoral) depths.	NO, SE	Includes	*Lophelia pertusa reefs*
	A4.7		Proposed removal of A4.7 "Deep shelf sediment habitats", and distribution of its level 4 types within A4.1-A4.4 (keeps units of same sediment type together).			
	A4.71		Move to A4.1			
	A4.72		Move to A4.2			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
	A4.73		Move to A4.1			
	A4.74		Move to A4.3			
	A4.75		Move to A4.4			
	A4.76		Move to A4.4			
Features of sublittoral sediments	**-**		Proposed new level 3	North-east Atlantic		
Seeps and vents in sublittoral sediments	A4.8		Relegate A4.8 "Seeps and vents in sublittoral sediments" to level 4 within new level 3 (features of sublittoral sediments).	North-east Atlantic		
Organically-enriched or anoxic sublittoral habitats	**-**		Proposed new level 3 within A4 to include A4.35	NO, UK, Baltic		
Periodically and permanently anoxic sublittoral muds	A4.35		Move from A4.3	NO, UK, Baltic		
Deep seabed	**A5**		No change	North-east Atlantic		
Deep-sea rock and artificial hard substrata	**A5.1**		Name change from "substrates" to "substrata"	North-east Atlantic		
Deep-sea bedrock	A5.11		No change	North-east Atlantic		
Deep-sea artificial hard substrata	A5.12		Name change from "substrates" to "substrata"	North-east Atlantic		
Deep-sea manganese nodules	A5.13		No change	North-east Atlantic		
Boulders on the deep-sea bed	A5.14		No change	North-east Atlantic		
Carbonate mounds	-		Proposed new level 4 within A5.1	North-east Atlantic	Equals	Carbonate mounds
Deep-sea mixed sediment	**A5.2**		Name change from "Deep sea combination sediments"	North-east Atlantic		
Deep-sea lag deposits	A5.21		No change	North-east Atlantic		
Deep-sea biogenic gravels (shells, coral debris)	A5.22		No change	North-east Atlantic		
Deep-sea calcareous pavements	A5.23		No change	North-east Atlantic		
Communities of allochthonous material	A5.24		No change	North-east Atlantic		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Deep-sea sands	**A5.3**		Name change from "Deep-sea sand substrates"			
Communities of bathyal detritic sands with [Grypheus vitreus]	A5.31		No change	Mediterranean		
Deep-sea muddy sands	**A5.4**		Name change from "Deep-sea muddy sand substrates"			
Deep-sea muds	**A5.5**		No change			
Abyssal hills	A5.51		No change			
Communities of bathyal muds	A5.52		No change	Mediterranean		
Communities of abyssal muds	A5.53		No change	Mediterranean		
Deep-sea bioherms	**A5.6**		No change	North-east Atlantic		
Deep-sea bioherm dominated by scleractinian coral framework	A5.61		No change	North-east Atlantic	Includes	*Lophelia pertusa reefs*
Deep-sea sponge aggregations	A5.62		Name change from "Deep-sea bioherm dominated by Porifera"	North-east Atlantic	Equals	Deep sea sponge aggregations
Communities of deep-sea corals	A5.63		No change	Mediterranean	Includes	*Lophelia pertusa reefs*
Canyons, channels, slope failures and slumps on the continental slope	**A5.7**		No change	North-east Atlantic		
Active downslope channels	A5.71		No change	North-east Atlantic		
Inactive downslope channels	A5.72		No change	North-east Atlantic		
Alongslope channels	A5.73		No change	North-east Atlantic		
Turbidites and fans	A5.74		No change	North-east Atlantic		
Deep-sea trenches	**A5.8**		No change			
Deep-sea reducing habitats	**A5.9**		No change			
Seeps in the deep-sea bed	A5.91		No change			
Gas hydrates in deep-sea	A5.92		No change	North-east Atlantic		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Cetacean and other carcasses on the deep-sea bed	A5.93		No change	North-east Atlantic		
Deep-sea bed influenced by hypoxic water column	**A5.A**		No change	North-east Atlantic		
Isolated 'oceanic' features: seamounts, ridges and the submerged flanks of oceanic islands	**A6**		No change	North-east Atlantic		
Permanently submerged flanks of oceanic islands	**A6.1**		No change	North-east Atlantic		
Seamounts, knolls and banks	**A6.2**		No change	North-east Atlantic	Includes	Seamounts
Summit communities of seamount, knoll or bank within euphotic zone	A6.21		No change	North-east Atlantic		
Summit communities of seamount, knoll or bank within the mesopelagic zone, i.e. interacting with diurnally migrating plankton	A6.22		No change	North-east Atlantic		
Deep summit communities of seamount, knoll or bank (i.e. below mesopelagic zone)	A6.23		No change	North-east Atlantic		
Flanks of seamount, knoll or bank	A6.24		No change	North-east Atlantic		
Base of seamount, knoll or bank	A6.25		No change	North-east Atlantic		
Oceanic ridges	**A6.3**		No change	North-east Atlantic		
Communities of ridge flanks	A6.31		No change	North-east Atlantic		
Communities of ridge axial trough (i.e. non-vent fauna)	A6.32		No change	North-east Atlantic		
Oceanic ridge without hydrothermal effects	A6.33		No change	North-east Atlantic		
Isolated 'oceanic' features influenced by hypoxic water column	**A6.4**		No change	North-east Atlantic		

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Vents in the deep sea	**A6.5**		No change	North-east Atlantic	Includes	Oceanic ridges with hydrothermal vents/fields
Active vent fields	A6.51		No change	North-east Atlantic		
Inactive vent fields	A6.52		No change	North-east Atlantic		
Pelagic water column	**A7**		No change	North-east Atlantic		
Neuston	**A7.1**		No change	North-east Atlantic		
Temporary neuston layer	A7.11		No change	North-east Atlantic		
Permanent neuston layer	A7.12		No change	North-east Atlantic		
Completely mixed water column with reduced salinity	**A7.2**		No change			
Completely mixed water column with reduced salinity and short residence time	A7.21		No change			
Completely mixed water column with reduced salinity and medium residence time	A7.22		No change			
Completely mixed water column with reduced salinity and long residence time	A7.23		No change			
Completely mixed water column with full salinity	**A7.3**		No change			
Completely mixed water column with full salinity and short residence time	A7.31		No change			
Completely mixed water column with full salinity and medium residence time	A7.32		No change			
Completely mixed water column with full salinity and long residence time	A7.33		No change			
Partially mixed water column with reduced salinity and medium or long residence time	**A7.4**		No change			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Partially mixed water column with reduced salinity and medium residence time	A7.41		No change			
Partially mixed water column with reduced salinity and long residence time	A7.42		No change			
Unstratified water column with reduced salinity	**A7.5**		No change			
Euphotic (epipelagic) zone in unstratified reduced salinity water	A7.51		No change			
Mesopelagic zone in unstratified reduced salinity water	A7.52		No change			
Bathypelagic zone in unstratified reduced salinity water	A7.53		No change			
Abyssopelagic zone in unstratified reduced salinity water	A7.54		No change			
Vertically stratified water column with reduced salinity	**A7.6**		No change			
Water column with ephemeral thermal stratification and reduced salinity	A7.61		No change			
Water column with seasonal thermal stratification and reduced salinity	A7.62		No change			
Water column with permanent thermal stratification and reduced salinity	A7.63		No change			
Water column with ephemeral halocline and reduced salinity	A7.64		No change			
Water column with seasonal halocline and reduced salinity	A7.65		No change			
Water column with permanent halocline and reduced salinity	A7.66		No change			
Water column with ephemeral oxygen stratification and reduced salinity	A7.67		No change			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Water column with seasonal oxygen stratification and reduced salinity	A7.68		No change			
Water column with permanent oxygen stratification and reduced salinity	A7.69		No change			
Fronts in reduced salinity water column	**A7.7**		No change			
Ephemeral fronts in reduced salinity water column	A7.71		No change			
Seasonal fronts in reduced salinity water column	A7.72		No change			
Persistent fronts in reduced salinity water column	A7.73		No change			
Unstratified water column with full salinity	**A7.8**		No change			
Euphotic (epipelagic) zone in unstratified full salinity water	A7.81		No change			
Mesopelagic zone in unstratified full salinity water	A7.82		No change			
Bathypelagic zone in unstratified full salinity water	A7.83		No change			
Abyssopelagic zone in unstratified full salinity water	A7.84		No change			
Vertically stratified water column with full salinity	**A7.9**		No change			
Water column with ephemeral thermal stratification and full salinity	A7.91		No change			
Water column with seasonal thermal stratification and full salinity	A7.92		No change			
Water column with permanent thermal stratification and full salinity	A7.93		No change			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Water column with ephemeral halocline and full salinity	A7.94		No change			
Water column with seasonal halocline and full salinity	A7.95		No change			
Water column with permanent halocline and full salinity	A7.96		No change			
Water column with ephemeral oxygen stratification and full salinity	A7.97		No change			
Water column with seasonal oxygen stratification and full salinity	A7.98		No change			
Water column with permanent oxygen stratification and full salinity	A7.99		No change			
Fronts in full salinity water column	**A7.A**		No change			
Ephemeral fronts in full salinity water column	A7.A1		No change			
Seasonal fronts in full salinity water column	A7.A2		No change			
Persistent fronts in full salinity water column	A7.A3		No change			
Ice-associated marine habitats	**A8**		No change			
Sea ice	**A8.1**		No change			
Seasonal pack-ice	A8.11		No change			
Permanent pack-ice	A8.12		No change			
Ice floes	A8.13		No change			
Freshwater ice	**A8.2**		No change			
Large tabular iceberg	A8.21		No change			
Medium iceberg	A8.22		No change			

Habitat name (proposed or existing)	EUNIS code	UK code	Action proposed	Countries in which found (from data supplied)	Relation-ship to OSPAR priority habitat	OSPAR priority habitat
Small iceberg	A8.23		No change			
Bergy bit	A8.24		No change			
Growler	A8.25		No change			
Brine channels	**A8.3**		No change			
Brine channels in first year ice	A8.31		No change	North-east Atlantic		
Brine channels in multi-year ice	A8.32		No change	North-east Atlantic		
Under-ice habitat	**A8.4**		No change	North-east Atlantic		
Under-ice habitat in first-year ice	A8.41		No change	North-east Atlantic		
Under-ice habitat in multi-year ice	A8.42		No change	North-east Atlantic		

Annex 17 Draft Terms of Reference for 2005 WGMHM

The **Working Group on Marine Habitat Mapping** [WGMHM] (Chair: D. Connor, UK) will meet in Bremerhaven, Germany from 5–8 April 2005 to:

International programmes (Baltic, MESH North-West Europe, North Sea)

a) Develop a benthic/pelagic habitat map for the North Sea, based on data sources compiled or made available to the Working Group and compiled into a GIS, and to assess future data requirements and issues arising from the process;

b) Compare international habitat mapping methodologies, and work towards a best practice approach;

c) Review progress of international mapping programmes (e.g., MESH, EEA, Baltic, ICES);

National programmes (National Status Reports)

d) Present and review National Status Reports on habitat mapping activity during the preceding year according to the standard reporting format (presentations limited to 10 minutes per country).

Mapping strategies and survey techniques

e) Review progress on intercalibration and quality control of mapping techniques. To construct a habitat mapping decision tree that can be applied to various management issues, identifying base requirements and evaluate the incremental values of mapping techniques (primer document to be circulated 3 months prior to meeting);

f) To review the activities of the SGASC relating to acoustic seabed classification.

Protocols and standards for habitat mapping

g) Develop a working definition of the terms habitat and marine landscape/seascape for the purposes of mapping;

h) Further progress the development of guidelines for habitat mapping, including the review of developments of protocols and standards for habitat mapping within the MESH project and other relevant initiatives (a report of the MESH project should be circulated prior to the meeting);

i) Report on progress in the development of metadata standards for marine habitat mapping.

Uses of habitat mapping in a management context (human activities; implementation of Directives and Conventions)

j) Review the application of and needs for habitat maps in a management context, including case studies to illustrate particular applications.

Relevance of habitat mapping to other aspects of marine ecosystems (fisheries, pelagic)

None proposed for 2005, due to the extent of other proposed Terms of Reference.

WGMHM will report by 25 April 2005 for the attention of the Marine Habitat and the Fisheries Technology Committees, as well as ACE.

Supporting Information:

Priority	This group coordinates the review of habitat classification and mapping activities in the ICES area and promotes standardization of approaches and techniques to the extent possible.
Scientific justification and relation to Action Plan	a) WGMHM has worked towards the production of habitat maps for the North Sea, through the assessment of data requirements, considering various approaches to development of broad-scale maps and an initial acquisition of the relevant data sets. The WG has further activities planned over the 2004 intersessional period and needs to progress the development of international-scale maps. This activity is to be undertaken in collaboration with related activities on habitat mapping at the North Sea scale, particularly by the EEA, the Interreg MESH project and within SGNSBP. The geographic area to be covered is from the high water mark to deep water of the North Sea (according to the OSPAR Quality Status Report Region II and ICES areas VIIE, VIID, VIA, IVB, IVC). Preparation: Before the Meeting, data will be sourced and converted into GIS map layers for overlaying and active querying during the 2005 meeting. Efforts will be

	made to allow Meeting participants access to all information layers in advance of the Meeting. b) Following the progress of multinational programmes, in particular by NIVA for the EEA and within the Interreg MESH project, will help the WG in its work on a North Sea map; additionally any follow-up to the recommendations by the 2004 WGMHM for Baltic Sea mapping need to be considered. c) The work of the various large-scale and multi-national mapping programmes (e.g., by EEA and MESH) and the ICES North Sea work will provide different approaches, which can be assessed and compared, leading to guidance on suitable generic approaches to tackle the mapping of such large sea areas. d) The compilation of National Status Reports is required to keep abreast of current activities and bring attention to new initiatives, developing techniques and data availability. e) The availability of a range of mapping techniques and the variation in environmental conditions (habitat type, depth) lead to multiple choices in mapping strategies for any given study. Development of a decision tree is required to link the aims/requirements of proposed studies to available resources, the most suitable mapping techniques and to the environmental conditions of the study area in order to derive the best mapping strategies. f) The SGASC will further progress the development of an ICES Cooperative Research Report on Acoustic Seabed Classification, at its 2004 meeting and intersessionally. This work is of direct relevance to WGMHM activities. g) A practical working definition of terms is needed to reduce confusion in terminology and promote common understanding and use of terms. h) Continued development of guidelines and standards is necessary to improve the quality of habitat mapping studies, to increase the compatibility of generated data and to facilitate the aggregation of habitat mapping information for national and international reporting purposes. i) Sound data management is important in the archiving and distribution of data sets. Work on this started at the 2004 WGMHM. j) Habitat maps can have many different purposes; there is a need to compile a set of uses for this information, including worked examples, so that the potential application of this resource maps is more widely understood. Action Plan Nos: 1.4.1, 1.4.2, 1.4, 1.4.3.
Resource requirements	
Participants	Representatives from Member Countries with experience in habitat mapping and classification. Participation of the Baltic countries is particularly sought.
Secretariat facilities	
Financial:	
Linkage to Advisory Committee	ACE
Linkages to other Committees or groups	BEWG and SGNSBP, WGEXT, WGFAST and SGASC, SGEH (Baltic Committee)
Linkages to other organizations	OSPAR, HELCOM, EEA
Secretariat Cost share	