

## Data Collection Experience with the Marine Irish Digital Atlas

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### Summary

The development of an online data catalogue and repository requires the bringing together of data from a diverse range of organisations, which hold data in different formats, scales and levels of detail. As of July 31<sup>st</sup> 2005, over 80 datasets from 32 different organisations have been collected for inclusion in the Marine Irish Digital Atlas (<http://mida.ucc.ie>). This paper examines a range of issues in relation to data gathering and preparation for display in the MIDA web-based GIS, including availability of GIS-ready data, ownership, metadata quality and data gaps. These issues are of relevance to anyone wishing to share spatial data via a web-based GIS, particularly as Ireland moves closer to the reality of distributed systems and the Irish Spatial Data Infrastructure.

### Introduction

The need for publicly available data catalogues and improved accessibility to spatial information has been recognised in Ireland for some time. The Geospatial Information Directory (GEO-ID) (Bamps & Beusen 2004), supported by IRLOGI, was a successful demonstration of how a simple cataloguing system could help in data discovery. Unfortunately, GEO-ID is now somewhat out of date due to issues of maintenance and updating.

The European Commission’s Directive on the re-use of Public Sector Information (PSI) was recently transposed into Irish law (European Commission 2005). One of the requirements of this directive is that public sector bodies develop tools to make it easier to find material for re-use. The upcoming INSPIRE Directive will define standards and protocols to be used in the cataloguing and exchange of spatial data. Both of these directives, together with the development of an Irish Spatial Data Infrastructure (ISDI) (McCormack 2004), have given an impetus to research and development in the field of spatial data cataloguing and exchange.

The situation regarding difficulties of access to spatial data is also found in the coastal and marine domain. The Marine Irish Digital Atlas (MIDA), which is being developed by the Coastal and Marine Resources Centre of University College Cork, came about from the recognised need in the Irish coastal management and research community for a resource that would enable people to find existing coastal spatial data more easily (Dwyer *et al.* 2003). Technical advances in Geographical Information Systems (GIS) and in particular web-enabled GIS, have created the opportunity to develop Internet-based tools that provide not only a means to search data catalogues, but also to visualise and query spatial databases themselves.

There are twenty-one different statutory bodies with a remit for the regulation of some aspect of Ireland’s coastal zone (Cummins *et al.* 2004). Not only does each of these

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bodies hold data, but in some cases the task of collecting or generating data may have been contracted out to other organisations. In addition, there is a wide range of non-statutory bodies, such as universities, private companies and non-governmental organisations, which hold relevant data and information. In order to create the data and metadata repositories that underpin the atlas, it is necessary to identify, locate, collect and display geospatial data from these organisations. This is a large logistical challenge and a range of data related issues are being addressed, including availability, completeness, formats, documentation, permissions and costs, among other things.

This time-consuming process of data sourcing and acquisition from data owners is complicated due to the lack of data catalogues within organisations, nonexistent or poor-quality metadata and variations in data quality (Bartlett 1999; McCormack 2003; O’Dea *et al.* 2004). Recommendations from members of the coastal community include the need for tools to facilitate searching for and access to spatial data in order to determine, evaluate and monitor what exists (Bartlett 1999; Connolly *et al.* 2001; Dwyer *et al.* 2003).

Organisations such as the Marine Institute (MI), the Geological Survey of Ireland (GSI), and the Department of the Marine (DCMNR) have recently implemented web GIS to provide a public service or to market their data. No matter what the purpose, web GIS developers and spatial data managers often run into similar challenges with issues involved in displaying data on the Internet, such as variability in data quality, scale, data licensing and metadata (O’Dea *et al.* 2004; Department of Environment, Food and Rural Affairs 2002). When a web GIS, such as the MIDA, displays spatial data from multiple data sources as opposed to from a single organisation, these issues are compounded by differences in data management practices, including the existence of or differences in data catalogues and standard specifications. Even if the technology is in place, the underpinning data issues must first be addressed in order for the technology to be useful (Bartlett *et al.* 2004).

The MIDA is addressing challenges in both the areas of data accessibility and web GIS design and the experiences of the project can help inform the development of other spatial data catalogue and exchange systems that incorporate web GIS. This paper focuses on data issues. It firstly outlines the approach to data collection; it then presents a number of statistics concerning the data and metadata collected for the MIDA and finally it discusses the implications for similar data cataloguing and presentation initiatives.

### **Approach to Data Collection**

The overall conceptual design for the MIDA data repository involved the categorisation of the layers to be collected into four classes, namely management, physical environment, biological environment and socio-economic activity. Sub-categories within these were then identified and an exhaustive list of all relevant data layers that could be included within each of these sub-categories was made. As a result of feedback from two workshops held with potential data suppliers and atlas users, a subset of priority datasets was identified. These datasets were considered to be those most commonly requested and of widest interest. Efforts focussed on trying to gather data in these areas first. Data collection is a continual process for the MIDA team and is expected to continue over the lifetime of the atlas.

In order to identify data holders, various sources are used; primarily the Internet, paper reports and professional contacts. Contact with data holders is made by telephone, e-mail, letter and site visits. In general, following a description of project objectives, data owners are willing to make data available via the MIDA, subject to certain conditions (e.g. no download, acknowledgement of data source, generalisation of detailed data). General and specific data supply and use conditions have been formalised in a Memorandum of Understanding drawn up by the CMRC and each data owner is given the option to sign. This document is useful for long-term data management, and will help to avoid misunderstanding between data owners and the MIDA management team in the future.

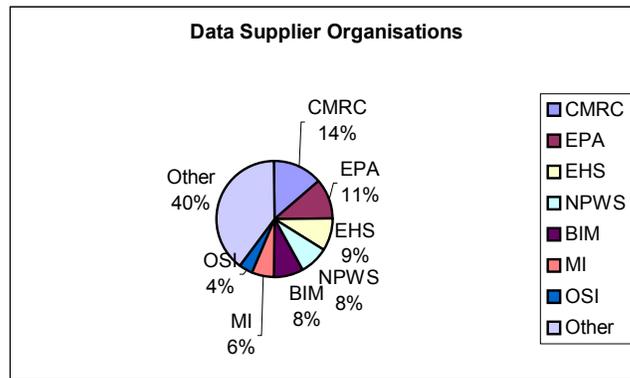
The MIDA is an all-island atlas, containing datasets and information of relevance to both the Republic and Northern Ireland. The focus has been on national and island-wide datasets, rather than those that are of relevance to a local area only. In the initial phase of the project, specific datasets for Northern Ireland were gathered on an ad-hoc basis due to limited resources within the project. However recently, the Environment and Heritage Service has funded a person for a 16-month period to work primarily on gathering and preparing Northern Ireland relevant datasets for inclusion in the atlas.

Users require that data meet a certain quality level before they will have confidence in using them. Many data are collected for a specific purpose, under certain conditions, and their use in other circumstances may not be appropriate. A risk of providing unlimited access to data is that there is no control on the use to which they may be put. Nevertheless appropriate documentation of a dataset's contents should help users evaluate its fitness for use. As part of the MIDA project, metadata is compiled for every data layer included, in order to reach a minimum and consistent level of documentation. This MIDA Discovery Metadata record contains 55 elements, saved in an XML file, which is compatible with the international ISO 19115 metadata standard. Generation of this metadata is proving to be a major task of the project given the variability in the original metadata supplied. Any metadata provided by a data owner is also displayed in the atlas, in the form in which it was supplied.

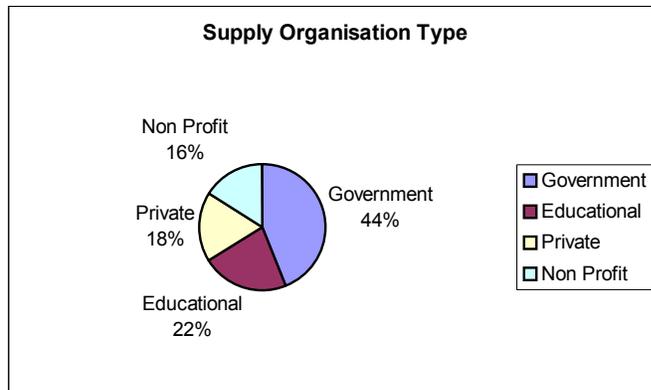
### **Data Collection Statistics**

As of July 31, 2005 a total of 80 datasets were available in the atlas or were in an advanced state of preparation for inclusion. These datasets come from 32 different organisations. Figure 1 shows that 60% of the layers come from only seven organisations. This represents approximately 20% of all data providers. It indicates that, although a large percentage of included data originates in a few organisations, data is spread across a wide number of organisations, with 40% of the data coming from the 25 others. Annex 1 lists all data layers collected and their owners.

Figure 2 shows the type of organisation that is providing data. Government bodies and agencies represent over 40%, while the rest is evenly distributed across educational/research establishments, private bodies and the non-profit/voluntary sector.



**Figure 1:** The percentage of datasets supplied by different organisations to the atlas.



**Figure 2:** Sectors to which data supply organisations belong.

Considering the total number of data layers sourced, 70% were in a GIS format and 19% were provided as tables of georeferenced points. The remaining 11% came in a range of formats or were digitised at the CMRC, based on information gathered from various electronic and paper sources. Regarding data supplied in GIS format, modifications are kept to a minimum before inclusion in the atlas. Data owners are considered responsible for data quality and completeness and the atlas should reflect what users can expect to receive from owners. Nevertheless, many layers require significant additional work before inclusion in the atlas. The most common tasks to be carried out include, but are not limited to: format changes (e.g. MapInfo to ESRI Shape), additions to attribute tables (e.g. adding link to site synopsis for Special Areas of Conservation), resolution of georeferencing issues (e.g. linear shifts, datums not specified) and joining of layers with attribute tables. For those non-spatial layers provided as a list of points it is relatively straightforward, although sometimes time-consuming to convert them to a point layer, due to differences in how their coordinates are defined (e.g. degrees decimal minutes vs. decimal degrees). In some cases associated attributes have simply to be extracted from tables supplied by the owners. In others, completely new attribute tables have to be created from disparate sources.

In quite a few cases data inconsistencies, omissions, errors, georeferencing problems and unexplained attributes are found. In order to attempt to solve these, contact is made with data owners. This often results in delays of weeks or even months before issues are resolved and the associated data layer is considered ready for inclusion in the atlas. For some, such as the National Parks layer, which is incomplete due to legal boundary concerns, layers are added with the known issue noted in the Discovery Metadata.

Of the 56 datasets supplied in GIS format, 32 were provided with some level of documentation or metadata. These metadata records varied in format and detail from simple text files outlining a dataset's contents, ownership and creation date to detailed ISO compatible reports including processing steps, dataset quality and accuracy. Metadata coming from the Marine Institute, EPA, GSI and BIM, were ISO compatible and constituted 60% of all that supplied. For the remaining 24 datasets no formal metadata was provided. In order to create the requisite Discovery Metadata records, a range of sources were used. These included primarily information supplied by email, data owners' websites, and telephone interviews with data owners.

## **Discussion**

### ***GIS Data Availability***

Although a large proportion of the datasets collected are in a GIS format, many of them require significant work before being put in the atlas. Some of the data have topological or georeferencing errors, and often attribute tables are incomplete or completely undocumented.

In certain cases no existing GIS-ready data could be found for what were thought to be common data (e.g. ports, marinas) therefore the CMRC generated new datasets from non-spatial data sources. This does not necessarily mean that a GIS dataset does not exist, but that it is not easy to find or its existence is not publicized.

In other cases GIS data is created by an owner for a specific project or a specific client, after which the data is not maintained, updated, catalogued or publicized. The outcome of this is that other organisations requiring such data may invest resources in generating similar or equivalent datasets again.

The Public Sector Information (PSI) Directive, as previously mentioned, requires that public-sector bodies make data available for re-use and it explicitly says that "practical tools that make it easier to find the material available for re-use" should be provided (European Commission, 2005). Implementation of this directive should improve accessibility of data created by and for public bodies in the future. Efforts are already underway with some, as previously mentioned, such as MI, EPA, and GSI.

### ***Metadata***

In 2002 the Irish government began developing the Irish Spatial Data Infrastructure (ISDI; McCormack 2004). The development of the ISDI is closely involved with the larger INSPIRE initiative for developing a European Spatial Data Infrastructure. ISO 19115 is the core of the metadata standard of the ISDI and INSPIRE, therefore the approaches taken in this project are in line with these future infrastructures (McCormack 2003). Although there is a growing awareness within the geospatial data

community of the benefits of metadata, those who collect or initially generate data are not always aware of how important it is, as can be seen from the lack of and variable quality of metadata received for the MIDA. There is a need to offer such people practical guidance and solutions for the generation and maintenance of metadata. Some of the currently available metadata entry tools (e.g. ESRI ArcCatalog) are not particularly easy to use for a novice or non-GIS expert and do not currently meet the full needs of the ISO 19115 standard. It is to be hoped that the ISDI will address this issue as part of its work. As illustrated previously, a large percentage of data are generated by non-public entities. While the ISDI will be a driver for providing standards for public bodies, means need to be made available to encourage the use of those standards by non-public entities as well.

### ***Ownership, Licensing and Costs***

For each dataset acquired it is important to identify its owner and a contact person who can provide interested atlas users with further information. Sometimes ownership is not completely clear. One organisation may have generated a dataset for a client, but it is not obvious if ownership resides with the generating organisation or the client. In other situations shared ownership is the case (e.g. saltmarshes which have multiple authors). Where third party datasets are used (e.g. OSI base maps) as part of the generation of another dataset, download from the MIDA is not made possible. Interested parties must contact the owners to acquire the data and ensure that appropriate third party licensing is in place before using them.

Certain datasets, such as those from OSI and SeaZone Solutions, are supplied under licence for display in the MIDA. These are commercially valuable data, so download is not made possible. Watermarking and visible copyright statements are conditions for Internet use. Other commercial datasets are also under consideration for inclusion in the atlas. In some cases the generation and display of low resolution versions are a recommended solution for preserving misuse of valuable data while giving users a taste of their content. The accompanying metadata refers to the original full resolution products that can be sourced from the data owner, while noting differences in the display version. In this case the MIDA acts as a shop window or a publicity vehicle for the data owner.

### ***Data Gaps***

At a series of recent regional user workshops regarding the MIDA, participants were asked what additional datasets they would like to see in the atlas. The most frequently requested thematic areas and datasets and the challenges involved in their collection are:

- Watersport and tourism facilities: Available from sports organisations, national and regional tourist bodies as addresses without geocodes; only member clubs held and therefore may not be exhaustive.
- Dive sites and wrecks: Information held by various organisations; in some cases it is considered sensitive; in other cases it is part of a commercial product.
- Fisheries: Information held by various organisations; in some cases it is considered sensitive; some data very general or incomplete.
- Flora and fauna: Extremely wide ranging thematic area; data and information held by a wide range of organisations; much information not in a GIS format or regional instead of national or island wide.

- Aerial photographs: Up to date images have a commercial value; images not georeferenced; large volumes of data.
- Seabed: Information considered of a commercial value.
- Tides and currents: information considered of a commercial value; restrictions on Internet use; freely available information very general.
- Outfalls: Information held by a large number of organisations; data may not be in a GIS format.

Currently the possibility of using Geodirectory (2005) is being investigated in order to add geocodes to address information and to facilitate its use in the atlas. Options for displaying commercial products, while protecting the commercial integrity of the data, needs further discussion with the relevant bodies.

## Conclusions

The first MIDA prototype went live in May 2005 and there are currently over 80 layers from 32 different organisations displayed or ready for display. Work on the atlas development has shown the challenges and difficulties encountered in identifying, collecting and preparing geospatial data from such a large number of organisations and on a wide range of themes. Although metadata was available for a large proportion of the GIS data sourced, this was very variable in quality, format and completeness. In many cases, GIS data did not exist or could not be found for what appeared to be important data layers.

The implementation of the Public Service Information (PSI) Directive should help to make it easier to find spatial data, as public organisations meet the new requirements to develop accessible catalogues of their holdings. The development of the ISDI and the ratification of the INSPIRE Directive will lead to a set of common standards for use in the preparation of metadata and geospatial data for public use.

Currently within Ireland a number of different web GIS of relevance to the coastal and marine communities are being developed by some of the key data owners. Steps are being taken to link some of these in a distributed system, therefore reducing the need for centralised repositories, which hold duplicate copies of metadata and data. This will leave control of the information with data owners and will improve efficiencies for both owners and users. Nevertheless, there will be an on-going need for repositories, such as the MIDA, to hold information from organisations that have very few datasets or those which do not have the resources to participate in distributed networks.

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### Acronyms

BIM	Bord Iascaigh Mhara
CMRC	Coastal and Marine Resources Centre
DCMNR	Department of Communications, Marine and Natural Resources
DEFRA	Department of Food Environment and Rural Affairs
EHS	Environment and Heritage Service
EPA	Environmental Protection Agency
GSI	Geological Survey of Ireland
INSPIRE	Infrastructure for Spatial Information in Europe

IRLOGI	Irish Organisation for Geographic Information
ISDI	Irish Spatial Data Infrastructure
ISO	International Standards Organisation
MI	Marine Institute
MIDA	Marine Irish Digital Atlas
NPWS	National Parks and Wildlife Service
OSI	Ordnance Survey Ireland
PSI	Public Service Information
XML	Extensible Markup Language

## Appendix 1

Data layers currently contained or ready for inclusion in the Marine Irish Digital Atlas

<i>Name</i>	<i>Description</i>	<i>Owner</i>
<b>Management</b>		
<b>Access Points</b>	Jetties, slipways and other access points to and from the sea	Marine Institute
<b>AONB</b>	Areas of Outstanding Natural Beauty	Environment and Heritage Service (NI)
<b>ASSI</b>	Areas of Special Scientific Interest	Environment and Heritage Service (NI)
<b>Biosphere Reserves</b>	UNESCO sites to promote solutions to reconciling conservation of biodiversity with sustainable use.	CMRC
<b>Border</b>	Border of the Rep. of Ireland	EPA, OSI
<b>Coastline</b>	Coastline of Ireland	OSI; GSHHS
<b>Clár Areas</b>	Rural areas targeted for investment	National University of Ireland Maynooth
<b>Designated Area</b>	Irish Designated Sea Area	GSI
<b>High &amp; Low Watermarks</b>	High & Low Watermarks	OSI
<b>ICES areas</b>	ICES fishing blocks	Irish Naval Service (INS)
<b>Irish Conservation Box</b>	Irish Conservation Box	CMRC, European Commission
<b>Gaeltacht Boundaries</b>	Gaeltacht Boundaries	GAMMA
<b>MNR</b>	Marine Nature Reserves	Environment and Heritage Service (NI)
<b>National Parks</b>	National Parks	National Parks and Wildlife Service (IE)
<b>NHAs</b>	Natural Heritage Areas	National Parks and Wildlife Service (IE)
<b>Nature Reserves</b>	Statutory Nature Reserves	National Parks and Wildlife Service (IE), Environment and Heritage Service (NI)
<b>Ports</b>	Commercial and Ferry Ports	CMRC
<b>Ramsar Sites</b>	Wetlands of international importance	National Parks and Wildlife Service(IE), Environment and Heritage Service

		(NI)
<b>Regions</b>	Local Authority Regions of Rep. Ireland	EPA, OSI
<b>River Basin Districts</b>	River Basin Districts for the Water Framework Directive	Environmental Protection Agency (EPA)
<b>SACs</b>	Special Areas of Conservation (NATURA 2000)	National Parks and Wildlife Service(IE), Environment and Heritage Service (NI)
<b>Sampling Sites</b>	Shellfish Sampling Sites	Marine Institute
<b>SPAs</b>	Special Protection Areas (NATURA 2000)	National Parks and Wildlife Service (IE), Environment and Heritage Service (NI)
<b>Straight Baselines</b>	Irish Straight baselines	Irish Naval Service (INS)
<b>Territorial limits</b>	Location of 6,12 and 200 nautical mile limits	Irish Naval Service (INS)
<b>Towns</b>	Towns over 2,000 people (1995)	EPA, OSI
<b>Water Quality</b>	Bathing Water Quality	EPA
<b>World Heritage Sites</b>	World Heritage Sites on the island of Ireland	CMRC

### *Physical Environment*

<b>450,000 base map</b>	1:450,000 base map image	OSI
<b>50,000 Webmap</b>	1:50,000 OSI Webmap images (coastal tiles only)	OSI
<b>Bathymetry</b>	GEBCO vector and gridded bathymetry	Natural Environment Research Council (NERC)
<b>Bathymetry</b>	SeaZone 100m vector bathymetry	Seazone/UKHO
<b>Coastal Lagoons</b>	Distribution of lagoons	Dr. Marinus Otte, CMRC
<b>Coastal Waters</b>	Coastal Waters	EPA
<b>CORINE Landcover</b>	Satellite interpreted landcover for 1990, 2000 and a map of changes in that period	Environmental Protection Agency (EPA)
<b>CTD</b>	Current, Temperature and Density Measurements	NUI-Galway, MI
<b>LaCoast</b>	LaCoast Coastal Change	EPA, Joint Reserach Commission
<b>LCA</b>	Landscape Character	Environment and Heritage

	Areas	Service (NI)
<b>Lifeboat Stations</b>	Lifeboat stations	Royal National Lifeboat Institution (RNLI)
<b>Lighthouses</b>	Lighthouses and other navigational aids	Commissioners of Irish Lights
<b>Main Lakes</b>	Main Lakes	EPA
<b>Main Rivers</b>	Main Rivers	EPA
<b>MODIS Image</b>	MODIS Satellite Image	NASA
<b>Rainfall</b>	Average monthly rainfall grid	Met Éireann
<b>River Basins</b>	River Basins	EPA
<b>Saltmarshes</b>	Significant saltmarshes on the island of Ireland	CMRC, T. Curtis and M. Sheehy Skeffington
<b>SST</b>	Average Monthly Sea Surface Temperature grid	NASA
<b>Seabed Survey</b>	Irish National Seabed Survey - areas surveyed	GSI
<b>SPOT Image</b>	SPOT Satellite Image of Ireland	LANDMAP
<b>Topography</b>	Shaded Topographic Relief at 50m spatial resolution	NASA-SRTM
<b>Marine Data Buoys</b>	Location of marine data buoys around the island of Ireland	CMRC
<b>National Monuments</b>	National Monuments in state care	National Parks and Wildlife Service
<b>Nutrients</b>	Nutrient Sampling Sites	Marine Institute
<b>Weather Stations</b>	Weather Data Collection Stations	Met Eireann, CMRC

### ***Biological Environment***

<b>Brown Crabs</b>	Brown Crab distribution in Northwest and Southwest	BIM
<b>Cetacean sightings</b>	Cetacean (whales, dolphins, porpoises) sighted in Irish waters	CMRC
<b>Cockles</b>	Cockle distribution around Dundalk bay	BIM
<b>Crayfish</b>	Crayfish distribution	BIM
<b>Fish Distribution</b>	Acoustic Survey	Marine Institute
<b>IBAs</b>	Important Bird Areas	Birdlife International, BWI,

		RSPB
<b>Lobster</b>	Lobster distribution	BIM
<b>Scallop</b>	Scallop distribution	BIM
<b>Shrimp</b>	Shrimp distribution	BIM
<b>Sea Bird sightings</b>	Sea birds sighted in Irish waters	CMRC
<b>Seaweeds</b>	Seaweeds	NUI Galway
<b>Seals - Harbour</b>	Harbour Seal Distribution	CMRC; NPWS; EHS
<b>Seals - Grey</b>	Grey Seal Distribution	CMRC; NPWS
<b>Periwinkles</b>	Distribution of significant periwinkle sites	CMRC, MI
<b>Whelk</b>	Whelk distribution	BIM

### *Socio-Economic Activity*

<b>Aquaculture</b>	Location of aquaculture farms	Dept. of Communications, Marine and Natural Resources (DCMNR)
<b>Blue Flag Beaches</b>	Blue Flag Beaches	An Taisce, Tidy Northern Ireland, CMRC
<b>Exploration Wells</b>	Exploration Wells	DCMNR, Petroleum Affairs Division
<b>Fishing Ports</b>	Fishing Port Locations	CMRC
<b>Marinas</b>	Location of marinas and pontoons around the island of Ireland	CMRC
<b>Moorings</b>	Location of tourist moorings	CMRC
<b>Petroleum Exploration Blocks</b>	Designated areas and licenced blocks	DCMNR, PAD
<b>Shore Angling</b>	Sites for shore angling as reported by anglers	Sea Angling Ireland